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THE
INTERCOLONIAL RAILWAY.

THE GENESIS
OF ITS
BRIDGES.

With the Official Documents laid before Parliament.

OTTAWA
1875.

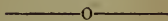
The EDITH *and* LORNE PIERCE
COLLECTION *of* CANADIANA



Queen's University at Kingston



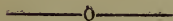
THE
INTERCOLONIAL RAILWAY.



THE GENESIS

OF ITS

BRIDGES.



WITH THE OFFICIAL DOCUMENTS LAID BEFORE PARLIAMENT.

OTTAWA
1875.

INTERCOLONIAL RAILWAY.

IRON *versus* WOOD.

DOCUMENTS SUBMITTED TO PARLIAMENT ON THE BRIDGE CONTROVERSY.

The Intercolonial Railway was undertaken by the Dominion of Canada, under a guarantee from the Imperial Government, as a National Work.

Preliminary surveys were made in 1864 by Mr. Sandford Fleming, who had been the previous year appointed to this duty by the Canadian and Imperial Governments. In the reports and estimates submitted by him on which the Imperial guarantee was based, provision was made for the erection of all the bridge structures with stone and iron. Mr. Fleming was subsequently appointed Chief Engineer to carry out the construction of the Railway, and he felt it incumbent upon him, to provide for all the works being executed as originally intended. Accordingly, in his specifications of the 6th October, 1868, issued under the authority of the Privy Council of Canada, it was set

forth that the bridges should have piers and abutments of the best description of masonry. It was likewise designed that the Railway should be carried across all streams on wrought iron girders.

The length of line to be constructed was about 500 miles. In this distance several large rivers and many less important streams had to be crossed. It appeared to the Chief Engineer, as the Intercolonial Railway was designed as a Military and National Road, and aided by the Imperial Government on the understanding that it should be permanently constructed, that it was indispensable that the bridge structures should be built of such materials as would lessen the risk of destruction at an inopportune time. Iron and stone being the most enduring materials, their use would do away with the risk of accident from fire or natural decay, inseparable from timber structures, and would render unnecessary the constant watching, the frequent interruptions to traffic, and the incessant expenditure in repairs which the use of timber involves.

The position of the Intercolonial Railway, touching the navigable waters of the sea at many points in its course, offered peculiar facilities for the delivery of iron, which, at little cost could be transported from the place of manufacture on the other side of the Atlantic, to the streams requiring to be bridged.

When the Chief Engineer prepared his first designs and specifications, he acted under the direct authority of the Privy Council. But on the 11th December following, four Commissioners were appointed to manage the construction of the Intercolonial Railway, and it became the duty of the Chief Engineer, as their principal executive officer, to act under them.

Contrary to the strongly expressed views of the Chief Engineer, the Commissioners resolved to change the character of the Railway by constructing the bridge spans of wood and not of iron.

This decision was quite at variance with the views of the Chief Engineer, not only because he felt it would degrade the character of the whole line, but equally because it brought him into conflict with those, with whom he desired to act harmoniously.

In the estimation of the public, the Engineer of any Railway, is responsible for the stability and permanence of its structures. If the work fail in any way, no Engineer escapes censure, unless it be established that his opinions have been overruled. Hence in important questions affecting the efficiency of his work, it is at times the duty of the Engineer to place on record his protest, when his views, officially expressed, are departed from, and his recommendations set aside.

In this matter, finding that his arguments had failed to convince the Commissioners, the Chief Engineer of the Intercolonial Railway, was constrained to appeal to the Privy Council. A controversy consequently commenced, which extended over a period of more than two years. The following documents, printed by order of Parliament, set forth the official history of this struggle, and record its satisfactory termination :—

No. 1, A letter to the Premier, Sir John A. Macdonald, from Mr. Fleming, dated 27th January, 1869. It is the first formal appeal of the Chief Engineer to the Government, against the decision of the Commissioners. Mr. Fleming submits his arguments in favor of iron, and against the introduction of wooden structures. These arguments if not unanswerable, have remained without reply. They were however not sufficient to effect an alteration in the decision of the Commissioners, except with regard to five of the bridges. The Commissioners persisted in their general determination to build the bridges of wood, and the Government sustained them.

No. 2, dated May 23, 1870. Is a statement prepared by the Chief Engineer for submission to Parliament. It gives in tabular form, a complete list of the bridges required to be constructed on the 500 miles of railway, together with his estimates of their cost. It also sets forth the fact, that substantial bridges of iron, could be erected throughout the whole line with but slightly increased cost over that of wooden structures, and strongly recommends that iron should be employed, in the place of the more perishable material, wood.

No. 3, dated July 3, 1870. A majority report of the Commissioners, to the Privy Council, signed by E. B. Chandler, C. J. Brydges and A. W.

McLelan, expressing their surprise at, and disbelief in, the statements and estimates of the Chief Engineer; and renewing their recommendation to the Government, that the bridges on the Intercolonial Railway, with the exception of the five above referred to, be built of wood and not of iron.

No. 4, dated July 5, 1870. Is a report to the Privy Council by A. Walsh, chairman of the Commissioners, in which he states his conviction, that iron bridges would not greatly exceed the cost of wooden structures; that the former would be much less likely to be destroyed by fire; that they would be more durable; and that, in his opinion, it would be true economy to construct all the bridges of iron instead of wood, as formerly determined by the Commissioners.

No. 5, dated July 7, 1870. Is an Order in Council, referring to the majority and minority Reports of the Commissioners of July 3rd and 5th. The Government concurs in the opinions expressed by the three Commissioners and adheres to the determination to build the bridges of wood.

No. 6, dated August 22, 1870. Is a letter from the Chief Engineer to the Secretary of the Commissioners, enclosing another remonstrance against the use of wooden bridges and asking that the work at River du Loup and Isle Verte be suspended for 10 days, until the Government have again an opportunity of reconsidering the question.

No. 7, dated July 26, 1870. Is a third appeal from Mr. Fleming to the Premier, Sir John A. Macdonald, re-stating all the arguments in favor of the use of iron for the bridges and earnestly urging that less perishable material than timber should be employed in the construction of the railway bridges, pointing out specially that wooden bridges would frequently be peculiarly liable to destruction, on the line of the Intercolonial Railway, through forest fires.

No. 8, dated September 23, 1870. Is a communication to the Privy Council from one of the Commissioners, Mr. C. J. Brydges, in which he combats the views of the Chief Engineer, as expressed in No. 7. Mr. Brydges argues that the fear of wooden bridges catching fire is entirely groundless, alludes

to his experience as Chief Manager of Railways in Canada for 18 years and conveys the impression that during his long experience he has never known a single instance of a wooden bridge being burned, or in which fires have injuriously affected a bridge in any way. He also states, as his belief, that the Chief Engineer's calculations of quantities and cost are entirely erroneous and unreliable and asserts that iron bridges would cost not less than \$300,000 more than the Chief Engineer's estimate and that it would not be surprising to him, if, by the adoption of iron bridges, \$500,000 would be added to the cost of the line, besides involving great delay and confusion.

No. 9, dated October 18, 1870. Is a communication from Mr. Fleming to Sir John A. Macdonald, respecting the statements made in No. 8. The Chief Engineer again points out that the risk of casualties by fire is great; that, on all railways where wooden bridges are constructed, they are a source of anxiety and a heavy charge against working expenses. That this is especially the case on the line, at that time managed by the writer of No. 8, Mr. Brydges. Mr. Fleming cites two instances of wooden bridges being totally destroyed by fire on the Grand Trunk Railway, only a few weeks before the date of document No. 8; to the destruction of at least one of which, it was subsequently discovered, the writer of that document, Mr. Brydges, was actually an eye witness. With regard to the assertion that the Chief Engineer's estimates are altogether wrong, and that iron bridges would cost from \$300,000 to \$500,000 more than the estimates of the latter; he, the Chief Engineer challenges examination into their accuracy and begs the Government to afford him an opportunity of testing them. In this document Mr. Fleming makes a final earnest appeal in favor of the erection of iron bridges.

No. 10, dated January 16, 1871. Is a Report from the Commissioners to the Privy Council signed by A. Walsh, E. B. Chandler, C. J. Brydges, and A. W. McLelan, enclosing a report from the Chief Engineer, on the question of the adoption of iron or wood for bridges. The Commissioners recommend in this document that all bridges over 60 feet span be constructed of iron

on certain conditions.

No. 11, dated January 19, 1871. Is an Order in Council, authorizing the building of all the bridges above 60 feet span of iron, instead of wood, whenever :—

1st. The Contractors assent, and the change can be made without increase of cost or payment of indemnity.

2nd. Where there is no material delay caused by the change.

3rd. Whenever the additional cost of the bridges will not exceed the estimate of the Chief Engineer, already submitted to Council.

No. 12, dated January 19, 1871. Is a letter from the Chairman of the Commissioners, to the Chief Engineer, directing him to carry the Order in Council (No. 11) into effect

No. 13, dated January 21, 1871. Is a letter from the Chief Engineer, to the Chairman of the Commissioners, with respect to the conditions of the Order in Council (No. 11).

No. 14, dated May 5, 1871. Is a report from the Chief Engineer, describing the course taken by him, to give effect to the Order in Council of January 19th, 1871 and stating that all the conditions of the Order in Council were or would be complied with. Further that Mr. Fleming had on his own responsibility ascertained by *bond fide* tenders, not only what the bridges over 60 feet span would cost, but at the same time, what those bridges, not authorized by the Order in Council, would cost if built of iron, viz : all bridges under 60 feet span. This report of the Chief Engineer establishes the fact, that every span on the whole line, ranging from 100 feet down to 24 feet, the *minimum*, can actually be completed in iron, by first-class bridge builders, including the cost of erection, for eight per cent. less than the Chief Engineer's estimate. It also establishes, with regard to the bridges of 60 feet span and less, not yet authorized by the Government to be built of iron, that their cost, if built of timber, under existing contracts, would actually be \$49,644 more than if built of iron after paying duty on the iron imported.

No. 15, dated May 10, 1871. Is a full report of the Chief Engineer, on all the tenders received for the erection of iron bridges throughout the whole line.

No. 16, dated May 11, 1871. Is a report of the Chief Engineer on the tenders for the erection of all spans over 60 feet and up to 100 feet, with a comparison of the prices in the tenders, with his own original estimate, showing that these spans can be erected of iron for seven per cent. less than his estimates.

No 17, dated May 11, 1871. Is a Report of the Commissioners to the Government, on the tenders for iron bridges, enclosing the Reports of the Chief Engineer. The Commissioners now recommend that all the bridges on the Intercolonial Railway be erected with spans of iron and that the tender of Clarke, Reeves & Co., for 16 spans of 200 feet each be accepted; also that the tender of the Fairbairn Engineering Co., for the erection of all the other bridges, throughout the line, be accepted.

No. 18, dated May 12, 1871. Is an Order in Council concurring in the adoption of iron bridges throughout the entire line of the Intercolonial Railway, authorizing their erection, and the acceptance of the tenders recommended.

In the interval between the dates of documents No. 1 and No. 14, a period of upwards of two years, during which the struggle was going on—three wooden bridges were erected, against the earnest protest of the Chief Engineer. Fortunately however, these are the only perishable bridges on the five hundred miles of Railway. All the other bridges on the line are now being built of iron, supported on massive masonry; and the accompanying documents establish the fact that these structures will actually cost less than if perishable material—timber—had been used, as at one time determined.

The Chief Engineer's original estimate of the cost of the structures referred to, including masonry, was, with *iron spans* \$1,294,607, and with *timber spans* \$1,293,459. The actual cost with *iron spans*, as now contracted for, will be \$1,274,029, or two per cent less than the first estimate.

R E T U R N

To an ADDRESS of the HOUSE OF COMMONS, dated 18th May, 1874; For a statement of the Cost of the Bridges on the Intercolonial Railway, showing the comparative costs of spans of wood and iron; with all correspondence and reports of the Commissioners, Engineers and others, submitted to the Government, and all Orders in Council on the subject.

By Command.

R. W. SCOTT,

Secretary of State.

DEPARTMENT OF SECRETARY OF STATE,
22nd May, 1874.

INTERCOLONIAL RAILWAY,
OFFICE OF CHIEF ENGINEER,
OTTAWA, May 22nd, 1874.

Edouard J. Langevin, Esq.,
Under-Secretary of State.

SIR,—I have been requested to furnish the information called for by an address of the House of Commons, with regard to the cost of the Bridges on the Intercolonial Railway, showing the comparative cost of spans of wood and iron, together with all correspondence, reports, Orders in Council, &c.

The desired information is contained in the documents which I herewith transmit, and of which the following is a list.

Yours, &c.,
SANDFORD FLEMING.

- No. 1. Extracts from letter from the Chief Engineer to Sir John A. Macdonald, dated 27th January, 1869.
- No. 2. Letter from the Chief Engineer to the Secretary of the Commissioners, dated 23rd May, 1870.
- No. 3. Commissioners' (majority) Report to Council, dated 5th July, 1870.
- No. 4. Chairman of the Commissioners' Report to Council, dated 5th July, 1870.
- No. 5. Order in Council, dated 7th July, 1870.
- No. 6. Letter from the Chief Engineer to the Secretary of the Commissioners, dated 22nd August, 1870.
- No. 7. Letter from the Chief Engineer to Sir John A. Macdonald, dated 26th July, 1870.
- No. 8. Memorandum by C. J. Brydges, one of the Commissioners, dated 23rd September, 1870.
- No. 9. S. Fleming to Sir John A. Macdonald, dated 18th October, 1870.
- No. 10. Commissioners' Report to Council, dated 16th January, 1871.
- No. 11. Order in Council, dated 19th January, 1871.
- No. 12. Chairman of the Commissioners to the Chief Engineer, dated January 21st, 1871.
- No. 13. The Chief Engineer to the Chairman of Commissioners, dated January 21st, 1871.
- No. 14. The Chief Engineer to Secretary of Commissioners, dated 5th May, 1871.
- No. 15. The Chief Engineer to Secretary of Commissioners, dated May 10th, 1871.
- No. 16. The Chief Engineer to Secretary of Commissioners, dated May 11th, 1871.
- No. 17. Commissioners' Report to Council, dated May 11th, 1871.
- No. 18. Order in Council, dated 12th May, 1871.

No. 1.

Extracts from a letter dated 27th January, 1869, from Sandford Fleming, Chief Engineer, to the Right Hon. Sir John A. Macdonald, Premier, urging the erection of Iron instead of Wooden Bridges on the Intercolonial Railway.

There is another point on which the Commissioners have, I think, prematurely come to a decision, and which seems to me to be worthy of attention. Originally it was proposed to build iron bridges. The plan of the Commissioners is to substitute wooden ones. They propose to build the bridges of pine.

This alteration invites attention to the comparative merits of wooden and iron bridges, under circumstances such as those now existing, and as the question seems to me one of very great importance. I trust the Council will not think me obtrusive in making this matter the subject of a few observations.

For half a century back a great deal has been heard of the pine forests of New Brunswick, and it is not to be wondered at that a proposal should be made to construct the bridges on the line of the Intercolonial Railway of timber instead of more durable materials, under the belief that there would be no difficulty whatever in rebuilding them from the adjacent forests as the timber in their construction from time to time fell into decay. There were at one time large tracts of most valuable pine in the Province of New Brunswick. Until lately the English market was largely supplied with timber from this quarter, but lumbering operations have been carried on to such an extent that all or nearly all the marketable pine along the numerous water channels, or within reach of them, has now been removed. So much is this the case, not only in New Brunswick, but also in Nova Scotia and Quebec, that, on an overland journey from Halifax to Quebec by any travelled route, the eye can scarcely detect a single pine tree. With regard to Nova Scotia, if the bridges in this Province be made of pine, I am satisfied it will have to be imported, and in New Brunswick

and Quebec, although a sufficient quantity to erect the first set of bridges may have escaped the axe of the lumberman, in some of the more remote recesses of the forest land, it will be no easy matter to renew them in the future with native timber. I state these facts from my own observations, for, although there are many persons who know particular sections of the country much more intimately than I do, there are not many who have travelled more through the three provinces in all directions, or had a better opportunity of acquiring knowledge respecting their natural features and productions. My own observations respecting the almost total destruction, at no distant day, of pine timber in these Provinces, is confirmed by statements from others. Only the other day, a gentleman who has been engaged during a life time in extensive lumbering operations, and who is now a member of the Senate, informed me that in twenty years there would be scarcely a pine tree standing in New Brunswick. I mention these facts in order to remove the mistaken impression that it would be an easy and inexpensive matter to rebuild timber bridges from the inexhaustible forests of the country, as they periodically fell into decay.

It has been shown as an actual statistical fact that, in the early days of railways in the United States, wooden bridges lasted on an average only ten years.—Latterly, greater care has been taken in their construction, as well as in their protection, and now the average length of the life of a wooden railway bridge has proved to be about twelve years. Taking the life of a wooden railway bridge, therefore, at twelve years, it is apparent that $\frac{1}{12}$ th, or $8\frac{1}{3}$ per cent. of the whole cost is chargeable against it every year for renewals. In addition we have the interest on capital consumed in its first construction, viz. four per cent. in this instance.

In comparing the relative cost of iron and wooden bridges there is another charge against the latter which the former is free from—I refer to the cost of employing watchmen as a protection against fire, a precaution absolutely necessary, at all events during the summer months, and which becomes no unimportant charge on the bridge of perishable materials. This charge might range, according to circumstances, from one to four per cent. on the cost of the bridge; but excluding altogether the wages of watchman from the comparison, we find that a wooden bridge is chargeable as above with $12\frac{1}{3}$ per cent. per annum for the use of capital employed in its construction and re-construction.

Generally speaking, an iron bridge can be put up for about double the cost of a wooden one.* Reckoning the money expended on its first cost at the rate of interest to be paid on the recent Intercolonial Loan, and as compared with a wooden bridge, costing double as much, we have, say eight per cent. per annum chargeable against the bridge structure, if iron instead of wood be employed.

This, I submit, is a fair way of comparing the cost of bridges built of wood and iron respectively, and from this it is clear that the bare charges on capital are as $12\frac{1}{3}$ is to 8, or, in other words, while the actual cost of a wooden bridge for construction and re-construction is $12\frac{1}{3}$, that an iron bridge is only 8, and if to the former be added the current expenses for watchmen, which are dispensed with in the latter, the difference in favor of the iron bridge is proportionately increased.

I do not say that iron bridges are everlasting, but the period when they will require to be rebuilt seems so remote that they may practically be considered permanent. The ordinary repairs of wooden bridges are always heavy—far more so than that of iron bridges. The latter require scarcely anything more than an occasional coat of paint; and this, wooden bridges ought also to have.

There is another way of putting this point, which illustrates very clearly the comparative economy of wooden and iron bridges, and that is, to estimate the annual burden on the resources of the country of building and maintaining the different structures.

* This opinion prevailed amongst engineers at one time, but it is only correct with respect to long spans, say over 150 feet,—the difference in cost between wood and iron diminishes rapidly as the spans shorten.—S.F.

If a bridge be built of iron, with capital like that in the hands of the Commissioners, at four per cent., the annual charge on the Revenue is, for every \$1,000 of the cost of construction, four per cent., or..... \$40 00

If, on the other hand, a wooden bridge be built, it will require but half the capital, and, consequently, at the outset, the charge for interest would be but..... 20 00

But as it would require to be rebuilt at the end of 12 years, and as in ordinary cases, capital will not probably be raised under six per cent., the second time it is built the charge would be \$30 to be added to the former \$20, making in all..... 50 00

After 24 years the charge would be..... 80 00
or double that of the iron bridge; but the disadvantage increases every time the structure requires to be replaced, till, finally, no comparison can be instituted between them.

From the foregoing it is evident, that although the immediate outlay on wooden bridges on the Intercolonial Railway, would be less than on iron bridges, when interest, renewals, watchmen, repairs, and all other expenses are taken into consideration, the former would actually cost far more than the latter.

The utility and economy of iron bridges is now pretty well established even in the United States, where, in the early history of railways, primitive constructions of wood were all that could be undertaken. In that country, the question was, and in some districts still is, not as to the superiority or economy of iron over wood, but, of a railway with temporary structures, or no railway at all. Previous to the outbreak of the late war, some of the important lines had commenced replacing their wooden bridges with iron structures. The New York Central had rebuilt some twenty-two of their bridges between Albany and Buffalo, constructing them entirely of wrought iron. In the Southern States numbers of iron bridges were also being erected.—The Pennsylvania Central as well as the Baltimore and Ohio, adopted the policy of replacing all wooden bridges with iron ones, as fast as the former gave out, and both these companies have renewed in this way, quite a number of their most important bridges with iron. And on the Hartford and New-Haven Railway, a single iron bridge has recently been completed at an expense of \$265,000. I may here note that this bridge took the place of a Howe Patent Truss, the second wooden bridge erected on the same site within 22 years.

In Canada we have had all the wooden bridges on the Northern Railway replaced by permanent structures of iron. On the Brockville and Ottawa Railway two spans of iron were erected last year at a cost of about one-half more than the original wooden structures, and five other spans of iron are being prepared for erection during the present year.

On the Great Western of Canada, a large number of the wooden bridges have been rebuilt with iron. This Company intend ultimately, I believe, to have the whole of iron; and they have only suspended the re-construction of the whole, in that material at once, for want of funds.

Fortunately the bridges on the Grand Trunk Railway are generally constructed of iron. Suppose in order to appreciate the importance of having those on the Intercolonial Railway of the same material, that the Victoria Bridge and all other bridges between Rivière du Loup and Sarnia were at the present moment of perishable material, and in an unsafe condition, as they would unquestionably be, if timber had been employed in their construction.

For a railway of such national importance as the Intercolonial, it would I think be a very grave error to build the bridges of wood. True, the traffic is not expected to be great, however, important in other respects the line may be, but this is really one of the strongest reasons why economy should be studied in avoiding temporary and perishable works. If the earnings of the railway are going to be light, it will never do to trust to the profits from traffic for the completion of the line in a permanent manner, or for the maintenance of perishable, and, in consequence, expensive works to keep up.

The saving effected in the first outlay, from the employment of wooden bridges, would be very small, not to be mentioned as an equivalent for the reduced standard of the railway, or for the increased annual charge for repairs and renewals, for the risk of accidents by fire, or for the increased danger to life and property.

The serious accidents which are constantly occurring through the failure of wooden bridges on American railways, to say nothing of the unseen risks more frequently run, ought to be a warning against their use in the present instance.

I have not yet remarked, in discussing the merits of wood and iron bridges, that the renewal of wooden bridges at several points on the Intercolonial Railway would be accompanied with a good deal of difficulty.

It would be necessary to erect temporary staging alongside of the bridge sites to carry the trains, while the old bridge was being removed and the new one constructed in its place. At some points this temporary structure alone would be very costly, besides which, a feeling of insecurity would be engendered in the public mind by them, and the necessity for their erection. These temporary structures would, of course, add to the cost of rebuilding the wooden bridges, and thus renewals would be more costly than the construction of the bridges in the first place.

I know of no section of country in the Dominion where iron bridges can be erected with equal advantage, or at less cost than on the route which the Government have fortunately selected for the Intercolonial Railway. Sea going vessels can reach within a short distance of all, or nearly all, the bridge sites, while the bridges can be built in England and brought out in parts of convenient size, which can be floated from the ship's side to the points where they are required, or to most of them.

Thus the charges for internal carriage and repeated handling, which are heavy under ordinary circumstances, are saved, or would be trifling, and therefore this increases the force of the contrast between the two kinds of structures in the present instance.

Having, I think, clearly shown that the iron bridges, in addition to all their other recommendations, are, in the long run, by far the most economical, I can only see one argument in favour of the adoption of wooden bridges, and that argument can only be used by those who view the union of the Provinces as an experiment very likely to prove unsuccessful.

If there is any probability of the railway being allowed in a few years to fall into disuse, then make not only the bridges, but everything else as primitive and temporary as possible; or, perhaps better still, build no railway at all. If, on the other hand, the Government have any faith in the union, and believe as I do that it is destined to last, then it will be studying true economy to make the railway as durable, substantial, reliable, and permanent as possible.

I do not enter upon the question how far we are morally pledged to the British Government to construct a railway of a permanent character. It is certain that all the calculations upon which the Imperial Government have acted have been based upon the idea of permanence. Whether they would have felt disposed to guarantee our bonds, if it had been put to them that the money received would have been expended in a manner to require the raising of another large amount at the end of twelve years, and that the political objects of the work could only be secured by our being able to borrow largely at that period for reconstruction or renewals. These and similar considerations I feel to be outside of the line of my duty, but they cannot fail to have some weight with the Privy Council.

I have said enough, I think, to convince you of the advisability of constructing the bridges of iron, as originally intended; and I may be permitted to add in a few words, my opinions with regard to the construction and character of the works generally.

Whilst avoiding extravagance and waste of every description, in all services and in every department of the railway;—whilst limiting the expenditure on stations to the simplest kind of accommodation, to meet the wants of the country in rolling stock, to the least supply at first likely to be required; and limiting the first outlay in a similar manner in all other services above and beyond that which constitutes the

roadway ;—I would advise, as true economy, that all works under the rail track should be solidly and carefully built, and of the most durable and imperishable materials.

No. 2.

Letter from the Chief Engineer to the Secretary of the Commissioners, of 23rd May, 1870.

(This document is embraced in document No. 7.)

No. 3.

Report of a majority of the Intercolonial Railway Commissioners to the Privy Council.

OTTAWA, 5th July, 1870.

The Commissioners appointed for the construction of the Intercolonial Railway beg to make the following report to Council:—

On the 18th December, 1868, a few days after their appointment, the Commissioners adopted a series of resolutions, relative to the course to be pursued in the construction of the Intercolonial Railway, amongst which was the following:—

“That the bridges on the line should be constructed of wood on the Howe Truss principle.”

This recommendation was submitted to Council and approved of.

Tenders were invited for the work upon that condition, the specifications and plans being prepared accordingly.

Four hundred and twenty-one miles of the line are now under contract, and the contractors are required by their contract to build Howe Truss bridges. Any departure from this now would involve changes and possible disputes of considerable magnitude.

In the report dated 15th March, 1870, made by the Commissioners, and which the Government laid before Parliament, the following was stated in regard to the bridges:—

“The Commissioners are of opinion that in the main, the bridges should be constructed of wood on the ‘Howe Truss’ principle. There are, however, several places where it will be desirable to construct them of iron. The principal points are at Trois Pistoles, Restigouche, Nipissiquit, Miramichi and Folly River; at these crossings the bridges will be either very long or high, and by adopting an economical description of iron bridges the cost will not be very much greater than if they were built of wood.”

This recommendation met with no objection in Parliament, and may therefore be treated as acquiesced in.

So far, therefore, as the Commissioners are concerned they have no other recommendation to make but renew their previous one, that the bridges be built of wood, with the exception of the five large and high bridges mentioned in their report of the 15th March, 1870, which they recommend should be built of iron.

Mr. Fleming having addressed a letter to them, dated 23rd May, 1870, upon the whole subject, the Commissioners think it right to submit his letter to Council.

They are much surprised at its contents, as it is so entirely opposed to all previous experience in the history of railways, and to Mr. Fleming's own opinion as expressed in his letter to Sir John A. Macdonald, on 27th January, 1869, wherein he gave his opinion that “generally” speaking an iron bridge can be put up for about double the cost of a wooden one.

The Commissioners cannot believe that iron bridges can be built at as low a cost as wood, and they are not prepared to alter their recommendations. The contracts are all let, and to change them now would cause great confusion, difficulty and cost.

(Signed,) ED. B. CHANDLER,
C. J. BRYDGES,
A. W. McLELAN,
Commissioners.

I concur in the above Report.

(Signed,) GEO. ET. CARTIER,
Acting for the Minister of Public Works.

No. 4.

(Copy.)

Report of the Chairman of Commissioners, dated 5th July, 1870.

The undersigned concurs in the recommendation contained in the foregoing Report, that iron bridges be constructed at Trois Pistoles, Metis, Restigouche, Nipissiquit, Miramichi, and Folly River; he cannot, however, concur in the recommendation that wooden structures be adhered to on the remainder of the line of the Intercolonial Railway.

Wooden bridges were adopted in the original specification, under the conviction that they could be constructed at about one-half the cost of iron structures, and this conviction was endorsed and sustained by the Chief Engineer, Sandford Fleming Esq., in his letter to Sir John A. Macdonald, of date 27th January, 1869, in which he stated "generally speaking, an iron bridge can be put up for about double the cost of a wooden one."

The calculations contained in the letter of the Chief Engineer of date 23rd May, 1870, the result (as he claims) of careful consideration, after making allowances for the differences in masonry, for the respective structures, make the cost of iron and wooden bridges almost precisely the same.

From the best information obtainable by the undersigned, he believes it a liberal calculation to assume, the total cost of iron superstructures as being 20 per cent. in excess of those of wood.

The experience of the present season has shewn that the bridges upon certain portions of the Intercolonial Railway will be liable to destruction by forest fires.

For the reason, therefore, that in his opinion the cost of iron bridges will not be more than 20 per cent. over those of wood, and considering the temporary character of wooden bridges as compared with iron, and their liability to destruction by fire, the undersigned is of opinion that it would be true economy to construct the bridges on the Intercolonial, of iron instead of wood, as originally specified, provided satisfactory arrangements for such substitution can be made with parties who have already entered into contracts based upon the original specification.

(Signed,) A. WALSH,
Chairman.

No. 5.

Copy of a Report of a Committee of the Honorable the Privy Council, approved by His Excellency the Governor General in Council on the 7th July, 1870.

The Committee of Council have given their attentive consideration to the annexed memorandum, signed by a majority of the Railway Commissioners, in reference to the relative advantage there will be in the construction of the bridges over the Intercolonial Railway line of wood instead of iron.

They have also considered the accompanying memorandum by the Chairman of the Commissioners, dissenting from the view expressed in the memorandum submitted by the majority of the Commissioners, and they respectfully report their concurrence in the opinion expressed by the latter, and recommend that with the exception of the bridges mentioned as necessary to be constructed of iron, the bridges on the Intercolonial Railway be constructed of wood on the "Howe Truss" principle.

Certified.

(Signed,) W. H. LEE,
Clerk, Privy Council.

No. 6.

Letter from the Chief Engineer to the Secretary.

INTERCOLONIAL RAILWAY,
OFFICE OF THE CHIEF ENGINEER,
HALIFAX, 22nd August, 1870.

SIR.—I enclose herewith printed copies of a letter which I have addressed to Sir John Macdonald, in order to bring the whole question of wood or iron bridges before the Government, before it is too late. This letter gives full information, and, I think, all explanations necessary to enable the Government to understand the subject perfectly.

It is not yet too late in any instance to secure the saving in masonry which would be effected by the adoption of iron instead of wooden spans, but as the contractors are ready to begin the abutments at Rivière du Loup and Isle Verte, and as their present instructions are to build abutments for wooden spans, I would suggest that these instructions be suspended, for, say ten days, until the Government has an opportunity of looking into the information now submitted.

I am, Sir,

Your obedient servant,
(Signed,) SANDFORD FLEMING,
Chief Engineer.

C. S. Ross, Esq.,
Secretary, &c.,
Ottawa.

No. 7.

Letter from the Chief Engineer to Sir John A. Macdonald.

INTERCOLONIAL RAILWAY,
OFFICE OF THE CHIEF ENGINEER,
To the Hon. Sir John A. Macdonald, K.C.B., HALIFAX, 26th July, 1870.
Minister of Justice, &c., &c.

SIR—I avail myself of the liberty you have given me to address you on any subject I may consider of sufficient importance in connection with the construction of the Intercolonial Railway,

I do not wish to trouble you with matters of little moment, and I would gladly avoid addressing you at the present time, if I felt I could fulfil my duty properly without doing so.

Before leaving Ottawa last month, I left for the consideration of the Commissioners, when they next met, a letter dated May 23rd, 1870, containing full information respecting every bridge on the Line of Railway between Rivière du Loup and Truro. This letter resulted from investigations and calculations instituted with the view of preparing a Return to the House of Commons, called for by a Resolution of the Hon. Adams G. Archibald (then M. P.). The following is the letter of instructions which I received directing me to furnish the calculations and other information.

INTERCOLONIAL RAILWAY,
COMMISSIONERS' OFFICE,
OTTAWA, 5TH MAY, 1870.

SIR,—The House of Commons have called for a Return—

1. "Showing so far as the same can at present be ascertained, the number of Bridges, above the size of culverts, required to be constructed on the Intercolonial Railway, the localities where the same are to be built, and the estimated cost: such Return to show the estimated cost if the spans are constructed of timber, and the estimated cost if constructed in iron.

2. "Also a copy of so much of the contracts for the construction of the road as contains the provisions, if any, for enabling the Commissioners to substitute iron for wood in the construction of bridges in case it may seem to them desirable to do so."

The Chairman desires that you will be so good as order a statement to be prepared, showing the particulars called for in the first part of the address, (the second part will be got in this office); when prepared, please send it over to me.

I am, Sir,

Your most obedient servant,

(Signed,)

C. S. Ross,
Secretary.

Sandford Fleming, Esq.,
Chief Engineer, Ottawa.

My letter of May 23rd, 1870, the result of careful enquiries instituted for the purpose of making the Return called for as above by the House of Commons, showed very clearly that it would cost scarcely any more in the first place to have every bridge on the line built of iron instead of wood. I explained the mode of calculation and everything else to the Chairman, the only member of the Commission I had frequent opportunities of seeing, and this gentleman did not hesitate to express his conviction that in the face of all the information obtained it would be a great mistake to build the bridges of wood instead of iron.

Since leaving Ottawa, I have been engaged on a tour of inspection over the whole line between Rivière du Loup and Truro, and I have seen many instances where the bridges if they had been built of wood, would have been destroyed, through the forest fires, which have raged in some cases for many miles along the line and on each side of it. In many such cases no precautions whatever could have saved wooden bridges from destruction.

Notwithstanding all this, I have recently received directions to have all the bridges, with six exceptions, made of wood, and fearing that my letter containing detail information and calculations has been over-looked or misunderstood, I deem it advisable, in the interest of the undertaking and the Government, to reproduce it in this way, and again point out how much better it would be, having in view economy, safety and durability, to have all the bridges made of iron instead of perishable materials.

(Copy.)

INTERCOLONIAL RAILWAY,
CHIEF ENGINEER'S OFFICE,
OTTAWA, May 23rd, 1870.

C. S. Ross, Esq., Secretary:—

SIR,—The following statement is prepared with the view of showing in tabular form a complete list of all the bridges required to be constructed on the line of the Intercolonial Railway. It gives the number and names of the bridges, as well as the localities where they are to be built, together with the number and length of spans in each bridge.

No. of Bridge.	Name of Bridge.	Division.	No. of Contract.	District.	No. and Length of Spans.						
					100 ft. Spans	80 ft. Spans	60 ft. Spans	50 ft. Spans	40 ft. Spans	30 ft. Spans	24 ft. Spans
1	Rivière du Loup.....	A	1	ST. LAWRENCE.	3						
2	Green River.....	A	1		2						
3	Trois Pistoles.....	B	2		5						
4	Mill Stream.....	B	2						1		
5	Grand Bic.....	C	5						3		
6	Little Bic.....	C	5		1						
7	Rimouski.....	C	5				7				
8	Beam Culvert (Sta. 1311)...	D	8								1
9	Metis.....	E	13		4						
10	Tartigouxx.....	E	13						1		
11	Sayabec.....	F	14							1	
12	St. Pierre.....	F	14			1					
13	Tobegote.....	F	14							1	
14	Amque.....	F	14		1						
15	Indian Brook.....	G	17	RESTIGOUCHE.					3		
16	Metapedia (near Forks).....	G	17		3						
17	Metapedia.....	G	17		2						
18	McKinnon's Brook.....	H	18			2					
19	Metapedia.....	H	18		4						
20	Clark's Brook.....	I	19						1		
21	Gilmore's Brook.....	I	19						1		
22	Restigouche.....	I	19		Five spans of 200 feet each.						
23	Christopher's Brook.....	K	3				1				
24	Mill Creek (Campbelton)...	K	3				3				
25	Eel River.....	K	3				3				
26	N. Branch Charlo.....	L	6					3			
27	S. Branch Charlo.....	L	6					2			
28	New Mills Brook.....	L	6					3			
29	Benjamin.....	L	6					3			
30	Nash's Creek.....	L	6					2			
31	Louison Brook.....	L	6					1			
32	Jacquet.....	L	6		3						
33	Belledunne.....	M	9			1					
34	Elm Tree.....	M	9				1				
35	Nigadoo.....	M	9			1					
36	Mill Stream.....	N	15			1					
37	Grant's Brook.....	N	15			1					
38	Tétégauche.....	N	15		5						
39	Middle.....	N	15			2					
40	Little River.....	N	15				1				
41	Nipissiquit.....	N	15		6						
42	Red Pine Brook.....	O	16	MIRAMICHI.					3		
43	Bartiboque.....	P	10			1					
44	Chaplin Island Road.....	Q	20							1	
45	N. W. Miramichi.....	Q	20		Five spans of 200 feet each.						
46	S. W. Miramichi.....	Q	20		Six spans of 200 feet each.						
47	Nelson Road.....	Q	20								
48	Barnaby.....	R			1						
49	Right-hand Branch.....	R							1		
50	Barnaby.....	R					1				
51	East Branch.....	R							1		
52	Kouchibouguac.....	R						3			
53	Kouchibouguacis.....	S					1				

No. of Bridge.	Name of Bridge.	Division.	No. of Contract.	District.	No. and Length of Spans.							
					100 ft. Spans	80 ft. Spans	60 ft. Spans	50 ft. Spans	40 ft. Spans	30 ft. Spans	24 ft. Spans	
54	Missiquash.....	W	11	NOVA SCOTIA.	1							
55	Nappan	X	4		1							
56	Coal Tramway.....	X	4								1	
57	Little Forks.....	X	4		1							
58	River Phillip.....	Y	7		3							
59	N. B. Wallace.....	Y	7					1				
60	Centre B. Wallace.....	Y	7				1					
61	Folly River.....	Z	12		5							
62	DeBert	Z	12		2							
63	Station 865.....	Z	12							1		
64	Ishgonish.....	Z	12		2							
65	North River.....	Z	12		2							
66	Salmon	Z	12		3							
Totals.....					60	10	19	18	15	5	2	

Total number sixty-six bridges, embracing the following spans, viz:—

16 spans of 200 feet each.	18 spans of 50 feet each
60 " " 100 "	15 " " 40 "
10 " " 80 "	5 " " 30 "
19 " " 60 "	2 " " 24 "

With regard to the probable cost of these bridges with iron or with wooden spans, I may mention, that in my letter to Sir John Macdonald, dated January 27th, 1869, when I ventured to offer some observations on the comparative merits of structures made of perishable and imperishable materials, I stated that bridges of iron might be taken to cost about double as much as bridges of wood, and even with this difference in favor of wood in the first cost, I satisfactorily established the economy of using iron instead of the more perishable material; while in advocating bridges of iron on principles of economy, it was proper that I should not overstate their advantages, and I therefore selected such cases as placed them in the least favorable light, it being clear to me, that if I showed the economy of adopting them in the least favorable cases it would be undisputed in all others.

Iron girders will cost about twice as much as wooden trusses in *large spans only*; in the great majority of cases there is much less difference between them, and the ratio between the first cost of wood and iron bridges changes with the length of spans, the difference diminishing as the spans shorten, until with very short spans there is really no very great difference. Out of the whole number of bridges to be built on the Intercolonial Railway, embracing 145 spans in all, ranging from twenty-four feet up to 200 feet, there are not more than three bridges where the cost of superstructure of iron would be double that of wood. These bridges are the Restigouche and the two Miramichi Bridges. It should be observed, too, that the difference in cost is not even in these cases so much as it appears, as it is only in the spans: the approaches, abutments, piers and costly foundation work, being common in both systems.

The Commissioners are aware that in a great many cases an iron bridge requires less masonry than a wooden bridge. I have had occasion to explain this to you in my letters bearing date July 2nd, 1869, January 26th and January 29th, 1870, with

enclosures, from which it would appear that as much as 1,000 cubic yards of masonry would be saved in one bridge alone, (the Trois Pistoles) by making the spans of iron instead of wood.

It appears from calculations which I have recently had made with as much care as possible, that the adoption of iron instead of wooden bridges would effect a saving in masonry on the line between Truro and Rivière du Loup of not less than 11,432 cubic yards.

This is a point of considerable importance, for although there may be less outlay on wooden spans than on iron spans, the additional cost of other works which go to form the whole bridge structure, really make (excepting the three cases referred to) the aggregate first cost of the bridges with wooden spans scarcely less than if they were finished with iron spans in the first place.

In proof of this I shall now submit approximate estimates of the aggregate cost of all the bridges on the line, excepting only the three specially mentioned, with large spans, viz:—one over the Restigouche and the two over the Miramichi.

The first estimate is calculated for the spans of wood, the second is for spans of iron, and it will be clear that the omission of the Restigouche and the two Miramichi Bridges is not important, as the Commissioners and the Government have now decided that these shall be made of iron.

Estimate with Spans of Wood.

73,560 cubic yards of masonry in the aggregate in abutments and piers.....	@ \$13.34=	\$981,290
60 spans of 100 feet @ \$3,471 per span.....		208,260
10 " 80 " 2,486 "		24,860
19 " 60 " 1,472 "		33,098
18 " 50 " 1,442 "		25,956
15 " 40 " 1,143 "		17,145
5 " 30 " 450 "		2,250
2 " 24 " 300 "		600
		<hr/>
		\$1,293,459

Estimate with Spans of Iron.

62,128 cubic yards of masonry in the aggregate in abutments and piers.....	@ \$13.34=	\$828,787
60 " 100 feet @ \$5,600 per span.....		336,000
10 " 80 " 3,750 "		37,500
19 " 60 " 2,200 "		41,800
18 " 50 " 1,600 "		28,800
15 " 40 " 1,200 "		18,000
5 " 30 " 600 "		3,000
2 " 24 " 360 "		720
		<hr/>
		\$1,294,607

In explanation of the above estimates, I may state that the quantities of masonry have been taken wherever it could be done, from the printed schedules, and the whole has been calculated from the lithograph plans published for the information of intending contractors. The iron girders have been computed at fair prices, and for other items, a mean has been taken of the prices given in all the tenders which I have as yet had access to, viz., the tenders first sent in for sections Nos. 1 to 12 inclusive.

From these estimates it would appear, that the first outlay on the bridges if made of iron would practically be about the same as if made of wood, when everything is taken into account.

Of course it must be allowed that a change in the rates will affect the total amounts in these estimates one way or another, but no change can be made, within reason, that would materially affect the comparison. From this comparison and what has already been advanced, it is clear that on every principle of economy the bridges on the whole length of the Intercolonial Railway should be made of iron. I would, therefore, most strongly recommend that every bridge on the line be made of iron instead of wood, and that steps be immediately taken to enter into arrangements for their construction with respectable bridge-builders.

A final decision should be made on this question at once as the contractors are pressing for plans of the masonry of bridges, and a loss will result if any change in the plan is made after the work is commenced.

I shall be prepared to furnish general specifications of iron girders and all information required by bridge-builders in making their proposals, whenever the Commissioners request.

I am, &c.,

(Signed,)

SANDFORD FLEMING,
Chief Engineer.

I may add to what it is expressed above, by way of farther explanation, that the estimates coming out so nearly alike is a purely accidental matter. I purposely avoided making the computations at rates fixed by myself for reasons which will be understood. I employed the *mean* of the prices given in the Contractors' tenders, thus bringing to bear on the question of value, not my own views, but the opinions of the hundreds who tendered, including many good practical men. This course was adopted in every instance except one, viz.: The price per ton of iron girders: in this case no prices have as yet been furnished by parties tendering, and for this alone am I responsible.

I need scarcely trouble you with any lengthy explanation showing how iron bridges do not require so much masonry as wooden bridges. I have done so frequently to the Commissioners verbally, and also by letters dated July 2nd, 1869, January 26th and 29th, 1870; and so well satisfied were they on this point, that in certain cases which then came up, they decided to abandon wood and use iron. The cases referred to are the bridges at Trois Pistoles, Metis Restigouche, Nepissiquit, Miramichi, and Folly River. Since then more extended inquiries and calculations, embracing every bridge structure on the line, establish the fact that not less than about eleven thousand four hundred (11,400) cubic yards of first class masonry would be saved by using in every case iron instead of wood for the spans.

This reduction in masonry represents a saving not far short of \$150,000, a sum quite sufficient to compensate for the extra cost of iron over wooden spans.

I am aware that this rather astonishing result is at variance with preconceived ideas. Many will be surprised to learn that the Intercolonial Railway can be finished from end to end with iron bridges at scarcely any greater first cost than with wooden ones. This, however, is substantially the case, and it will be found on investigation to be mainly due to the peculiarly simple designs for bridge masonry, which have been prepared for the several structures. With regard to these designs a few words of explanation may not be out of place. They have been prepared with the most careful regard for economy whilst the greatest permanency and fullest efficiency have been aimed at; they were prepared under instructions from the Government when tenders were first invited in 1868, and they were fully matured and lithographed before the Commissioners were appointed. It is important that I should mention this, to prevent the possibility of a charge being made, that I have only now prepared the designs for iron bridge structures, and that I have unduly reduced the quantity of material in order to make out a case, it being well known, and I have no desire to conceal the fact, that I strongly favor iron instead of wooden bridges. These designs were carefully considered and matured long ago, when there was really no question open; it was then a settled conviction (with me at least,) that all the

bridges would be made of iron, and that the construction of wood would never be thought of. As already mentioned, I even went so far as to have the designs lithographed.

These lithographed designs are those from which the calculations of quantities herein referred to are made. Of course some changes were necessary to adapt them to spans of wood, but these alterations consisted in simple and necessary enlargement to suit the more cumbersome structures of timber, the same economic designs being as far as possible carried out.

In proof of what I have advanced, it may suffice at present to make a comparison between the Intercolonial Railway designs for bridge masonry, and designs carried into execution on another railway.

A few months ago, one of the Commissioners, Mr. C. J. Brydges, favored me with copies of four different plans of abutments which have been used on the Grand Trunk Railway. Each design calculated for a height of sixty feet gives the following quantities of masonry :—

Design No. 1	Grand Trunk Railway,	3,230	Cubic Yards.
" 2	do do	2,060	do
" 3	do do	2,260	do
" 4	do do	2,310	do
Average	do do	2,465	do

The Intercolonial Railway designs calculated for the same height, sixty feet, gives as follows :—

For wooden spans	1226	cubic yards.
For iron spans	760	do

Thus showing that while the average quantity of masonry in abutments built on the Grand Trunk is 2,465 cubic yards, on the Intercolonial it would only be 1,226 cubic yards for wooden, and 760 cubic yards for iron spans.

Had the same designs been adopted for the Intercolonial Railway as those we find built on the Grand Trunk, it is evident that the quantity of masonry and consequently the cost of the whole line would have been very materially increased. Fortunately we have adopted another design which reduces the masonry very considerably, and this design is more especially advantageous in an economic point of view when iron girders are used. According to the above comparison, this design reduces the masonry *one-half* for wooden spans, and to *less than one-third* for iron spans.

It will now be clear to you how the bridges, under the circumstances which obtain on the Intercolonial Railway, can be finished as cheaply with iron as with wooden spans.

It was undoubtedly stated at one time by some authorities, and without much examination accepted generally as correct, that the cost of iron bridges would prove about double the cost of bridges made of wood. This may still be correct under certain circumstances, but the rule does not appear to be borne out by a careful investigation into the whole question under the conditions which exist on this line of Railway.

I shall not trouble you with any further observations on the subject, beyond saying that whatever may have been believed at one time as to the comparative cost of iron and wooden bridges, so soon as the Commissioners and the Government discovered that in two or three cases the employment of iron would involve no greater outlay when everything was considered, than wood, they resolved to adopt iron. I have now shown that every bridge on the line can be built of iron instead of wood without any, at least without any material extra cost; and I naturally conclude that when the matter is properly represented and understood, the same rule which guided in a part, will govern with regard to the whole. The sole aim of this communication is to make the matter understood before it is too late, and in this I trust I have to some extent succeeded.

So well satisfied am I of the importance of the question, and the serious and irremediable mistake it would be to defer any longer the decision of the Government to use iron instead of wood, that I have thus ventured specially to draw attention to the subject; and I further feel it my duty to point out that it would be advisable to have the instructions to build wooden bridges, suspended until the whole matter is reconsidered; no harm can possibly result from this, as the Contractors, who are ready to begin bridge work, are begging for the adoption of iron bridges in order to reduce their masonry.

I may add that in anticipation of any possible change from wood to iron bridges, recent contracts contain a special clause providing for the change, so as to obviate any difficulty with Contractors.

The following is the clause referred to:

"*Provided* always that if the Commissioners shall at any time hereafter think fit to substitute the erection of iron bridges, for the bridges or wooden superstructures specified in the General Specifications forming Schedule A of this contract, then, and in every such case, the Commissioners shall be at liberty to make such substitution at any time before the Contractors shall have commenced the actual laying of the foundations of the masonry for receiving the superstructure, and in every such case the Commissioners, upon giving notice to the Contractors of the intended substitution, may proceed to the procuring the necessary materials for and to the erection and completion of the superstructure of such iron bridge at the cost respectively of Her Majesty, and the Contractors shall thence be relieved from the necessity of erecting, at such place or places the bridge or wooden superstructure as specified in the General Specification forming Schedule A of this contract. But in every such case the value of the wooden superstructure, and the reduction in quantity and value of masonry (if any) consequent upon such substitution shall be deducted at the prices named for such descriptions of work in the Schedule hereunto annexed, from the full amount herein mentioned as payable, and to be paid for the performance of the work under this contract."

Thus it will be seen ample provision has been made for enabling the Commissioners to substitute iron for wood in the construction of the bridges without involving themselves or the Government in complications or difficulties of any kind with the Contractors: it now only rests with the Government to decide finally whether all the bridges on the Intercolonial Railway shall be built of iron or wood—whether for about the same actual expenditure they shall be really permanent, or merely formed of perishable materials, requiring to be renewed in a few years, and liable to be destroyed by fire at any time.

I have the honor to be, Sir,

Your obedient servant,

SANDFORD FLEMING,

Chief Engineer.

No. 8.

Memorandum of C. J. Brydges, one of the Commissioners.

The undersigned, one of the Commissioners for the construction of the Intercolonial Railway, begs to comply with the request made to him by the Government, that he would put in writing his views upon the question of the bridges for the Intercolonial Railway, rendered necessary by the last appeal which Mr. Sandford Fleming, the Chief Engineer, has made against the decision, at which the Government has repeatedly arrived upon this subject.

It is right, in the first place, to call attention to the fact that on the first appointment of the Commissioners, now nearly two years ago, the Government decided that the principle of wooden bridges should be adopted in building the Intercolonial Railway.

That decision was announced, and it formed the subject of several paragraphs in the report of the Commissioners, which was laid before Parliament at its last session. That report, recommending the general adoption of wooden bridges, was before Parliament for a considerable part of its session, and no proposal was made to vary the decision, which the Commissioners had recommended, and which the Government arrived at.

It is safe therefore to say that Parliament, so far as it had any opportunity of considering the question, has acquiesced in the general propriety of the decision at which the Government had arrived.

The only reference to the matter in Parliament, was a return asked for by a member of the House, asking for a statement of the relative cost of wood and iron bridges. In answer to this, a return was prepared by Mr. Fleming, and his opinion recorded in a letter addressed to the Commissioners, dated the 23rd of May, 1870. These documents were very fully and very carefully considered by the Commissioners, and the majority of them, *i.e.* three out of four, reported in writing to Council, that they did not concur in the views expressed by Mr. Fleming, and they adhered to their original opinion, that it was not desirable to build the bridges on the Intercolonial Railway of any material except wood.

The whole question, including Mr. Fleming's letter of the 23rd May, 1870, was submitted to the Government a couple of months ago, and they came to the decision that it was not desirable to change the course which had already been determined upon.

Mr. Fleming's appeal therefore, now, in the communication addressed to Sir John A. Macdonald, is an appeal, not from any decision of the Commissioners, whose only duty it is to carry out the decisions of the Government, but an appeal against the formal decision, after consideration of the Government itself.

Before dealing with the general question it is necessary to review some of the statements contained in Mr. Fleming's letter to Sir John A. Macdonald.

Mr. Fleming prominently refers to the danger of fires arising in the woods through which the Intercolonial Railway will run, extending to the railway and burning wooden bridges.

The undersigned is of opinion that this is not an argument of any weight.

The undersigned has been connected in the chief management of railways in Canada for a period now of nearly eighteen years, and during that time it has been his duty to manage railways extending from the Detroit River at one end of Canada to Rivière du Loup (and Portland on the Atlantic) at the other.

Many miles of railway, in this very extensive district, runs through extensive forests in which fires occur every year; and upon these railways there are at this present moment a great number of wooden bridges, which would of course be subject to danger from the cause suggested by Mr. Fleming. It is only necessary to say that during the whole of the eighteen years referred to, the undersigned has never known a single instance in which large fires, burning upon either or both sides of the track of the railway, have burned a wooden bridge, or have in any way whatever injuriously affected a bridge of any kind or sort.

The "Intercolonial," like all other railways in Canada, will be cleared for an average distance of fifty feet on either side of its track. This of itself is calculated to prevent the danger which Mr. Fleming supposes possible, added to which, experience has shown that the number of persons necessary to be employed in the working of a railway, is always sufficient to prevent the possibility of a danger, from the cause of fires raging in the woods, injuriously affecting such parts of it as its bridges.

The undersigned, therefore, from experience of so many years, cannot attach any weight to the danger which Mr. Fleming has suggested.

Mr. Fleming states in a further part of his letter, that, so well satisfied were the Commissioners, as to the economy, as regards masonry, of iron bridges over wooden ones, that they decided to make six of the bridges of iron instead of wood. The reason given by Mr. Fleming for the decision, at which the Commissioners arrived, is not the correct one. It was in no way whatever because they believed that any large

saving would be effected, or that economy would be promoted by the substitution of iron for wood, but because the peculiar circumstances of the six bridges referred to rendered it desirable in the opinion of the Commissioners, that those particular structures, and those only, should be made of iron. Their reasons for arriving at this decision were, that the six bridges were all long, that they were high, and that therefore any accident which might possibly arise to them, would be calculated to interfere with the traffic of the line, and it was simply these reasons, viz., their great length and their height, that brought about the decision, which was in no way effected whatever by the difference in the quantity of masonry required.

Mr. Fleming, in one of his early letters to the Government, after the Commissioners were appointed, made a distinct and positive statement that iron bridges would cost about double that of wooden bridges.

It is to be presumed that Mr. Fleming had reasons for making that statement, and about its correctness there can be no doubt, as it is in accord with the universal experience of engineers, and of all those who have had anything to do with the construction of railways. Now, however, Mr. Fleming distinctly states that the bridges on the Intercolonial Railway, from end to end, can be constructed of iron at practically the same cost as if they are constructed of wood.

The undersigned can only express his great astonishment at any engineer making such a statement.

Mr. Fleming's original opinion, as stated in his letter to the Government, has been modified; as appears by his letter of the 23rd of May and 26th July, 1870, not from any subsequent experience which he has had in the construction of wooden or iron bridges, but upon theoretical data only, which if true, is a most wonderful discovery.

Mr. Fleming states that his reason for this now is that by great simplicity of design in the abutments and piers he has been able to largely reduce the quantity of masonry required.

If this simplicity exists at all it must be equally applicable to wood as to iron; with the small differences that are required in heavy abutments where the track runs upon the upper chord of the bridge, when the track runs upon the lower chords there can be no diminution of masonry in the abutments, and as regards intermediate piers, the quantity of masonry will be greater for iron than for wooden bridges, owing to the depth of the truss for iron being less than for wood a greater length of masonry is required in the piers; any simplicity therefore that may have been devised will be equally applicable to one as to the other, and no advantage in the discussion can under any circumstances arise from this cause.

There is no doubt that as regards the contracts now existing it would be a serious departure from the principle upon which they are based, viz., that of paying a lump sum for the whole quantity of work to be done in each section, if the plan proposed by Mr. Fleming could be adopted, of making a deduction from the contracts, because as regards masonry a few yards more or less had been done away with.

It must be borne in mind that none of the contracts contained any reference to quantity whatever, and it is expressly stipulated that no matter what the quantity of any kind or description of work may turn out to be, the contractor shall not be entitled to have his contract varied on that account. If, therefore, so far as regards the majority of the contracts, any diminution was made in the quantity of masonry required, it would simply be a gain to the contractor, and the Government would not derive one farthing benefit from it. In a few of the late contracts a clause has been inserted, quoted by Mr. Fleming, the introduction of which it is not necessary again to refer to, after what occurred at the last meeting of Council, which Mr. Fleming thinks, as far as regards those five or six contracts, would alter the case. In the opinion of the undersigned, however, it would not do so, and for the reason that the contracts being based upon a lump sum, the contractor who would be called upon to submit to a deduction on account of masonry which he was not required to execute, would have an answer, first,—that there are no quantities shown in his contract at all,

and that it is impossible therefore to apply a question of diminution or increase to quantities which have no existence in the contract itself. He would also, even if the claim were admitted in regard to the diminution of quantity, be entitled to ask that he should be at any rate allowed to profit upon the work which he was requested not to perform, but which he would have made if the contract had been carried out as originally intended.

It must also be borne in mind that the introduction of such a system as this would be destructive of the principle of lump-sum contracts, and would entirely destroy the symmetry upon which the whole system is founded.

The contractor who, under the authority of such a clause, was called upon to submit to a reduction of his contract price because he did not execute some proposed quantity of work, which is in no way, whatever so far as regards quantity, referred to in his contract, would have a fair and just opportunity to turn round and ask the Government to pay him for any extra quantity of other kind of work that he might or may be called upon to perform in the execution of his contract, but which, under the principle of lump-sum contracts he would have no right to claim, because under the terms of his contract he has to complete the whole amount of work entirely regardless of quantities. The undersigned is therefore of opinion that as regards the majority of contracts, no diminution of quantity in masonry would ever be to the benefit of the Government, but to the sole benefit of the contractor; and as regards those contracts in which the clause referred to has been introduced, it would open the door to questions of the gravest doubt and difficulty, inevitably involving serious consequences in the settling up of the contracts after their completion.

Mr. Fleming states that the contractors are begging for the adoption of iron bridges, in order to reduce their masonry.

Whatever reduction may be arrived at by the adoption of iron instead of wooden bridges, would be, no doubt, pleasing to the contractors, because their contracts require them to do the whole work, and of course any diminution in the quantity required to be done would be solely and entirely for their benefit. The reasons of their desire for iron bridges are therefore obvious and selfish.

It is only necessary now to deal with the extraordinary fact, if it be one, as announced by Mr. Fleming, "that iron bridges can be built upon the Intercolonial Railway at as small a cost as wooden bridges; the difference in fact only being, according to his figures, some \$1,200. Mr. Fleming places the difference in masonry at \$150,000, arrived at by a reduction of 11,500 yards of masonry, which is equal to about 16 per cent. of the quantity required. It has been already stated that the same general design of abutments and piers will answer for either wooden or iron bridges, and the only difference is where the track runs upon the upper chord of the bridge, necessitating in that event a somewhat larger quantity of masonry in the abutments and a less quantity of masonry in each of the intermediate piers. When the track runs upon the lower chord of the bridge the quantity of masonry in the abutments of a wooden or iron bridge is precisely the same."

The undersigned having had very considerable experience in the construction of railways, is prepared to state that the difference of masonry, mentioned by Mr. Fleming, is not one which experience has proved to be correct.

After having gone carefully into the matter, and dealt with the question upon the supposition that the style of the abutments is the same for both descriptions of bridges, the undersigned is very clearly and strongly of the opinion that a sum of \$80,000 added to the cost of masonry, for wooden, as against iron bridges, would more than cover the extra cost. This is making a liberal allowance.

Then in regard to the cost of the iron superstructures instead of wood, the undersigned is satisfied that Mr. Fleming's estimate is very far below the cost, as regards iron. The sum named by Mr. Fleming for wood is about correct. But as regards iron there is a difference in the opinion of the undersigned, of not far short of \$200,000. The total excess of the cost of iron over wood, would, in the opinion of the undersigned, be from \$250,000 to \$300,000, or on the whole cost of the bridges, an increase by adopting iron of twenty-five per cent.

There cannot, in the opinion of the undersigned, be any doubt whatever that iron work for bridges could not be laid down and erected at the different points along the Intercolonial line of railway for any such sum as Mr. Fleming has estimated. Iron work can only (assuming it to come from England) be landed at certain places, at which large ocean vessels can reach the wharves. Those places would be Quebec, Miramichi, Dalhousie, Pictou, Halifax and St. John.

There are no other places along the coast where large vessels could come alongside of the wharves at any point.

If material had to be landed elsewhere they would have to be transhipped into smaller vessels, involving, of course, considerable extra expense, delay and risk. Assuming the iron work to be landed at the places named, the cost of hauling the material from those points to the different locations where the bridges have to be erected, would add very largely indeed to their cost, and there would be a great difficulty from the possibility of parts of the bridges being lost or injured in transit, involving delay and expense.

An iron lattice bridge is made up of a great many small parts, to be put together on the spot; the mixing or loss of parts of the bridges, in so large a quantity, would be almost certain to occur, and the absence of what would appear to be small parts of the bridge, at the spot where they were required, might cause delay in the completion of the structure for several months. There are 155 spans of bridges to erect. These will include many thousand pieces, all requiring each to be in their exact spot at the right moment. If a few pieces were lost it might delay the work for months.

The undersigned has no doubt whatever, that taking all these facts into consideration, and making every allowance for the saving in masonry, there would be an extra cost, if iron bridges are adopted, of not less than \$300,000, or twenty-five per cent. at least. It would be, possibly, a good deal increased by the difficulties which would arise with the contractors, if an attempt was made to vary their contracts, in the manner proposed by Mr. Fleming.

It is also clear that considerable delay would occur if iron be adopted instead of wood.

The quantity of iron bridges required is very large, and if ordered immediately would take some considerable time to be manufactured and placed upon the spot; none of it could reach any part of the St. Lawrence until the month of May next, and it would then be some considerable time after that before it could be in its place and ready to be erected.

Wooden bridges on the other hand, can be constructed during the coming winter at every place where they are required, and the bridges themselves ready by the time track-laying and ballasting is to be commenced next spring.

If iron is adopted, temporary bridges would be required in many places to allow of the track-laying to go forward, and these temporary bridges would add to the cost of the whole work.

It would not be surprising if the adoption of iron bridges added \$500,000 to the cost of the line, besides involving great delay and confusion.

Properly constructed wooden bridges, and well taken care of, with the light traffic that will exist on the Intercolonial, will last from twelve to fifteen years. There are wooden bridges now in existence on the Grand Trunk Railway, over which a very large traffic is passed every year, which are older than the longest time named. On the Railway from Buffalo to Goderich—161 miles, upon which there is a very considerable traffic, all the bridges are of wood, and any renewals that have had to be made, so far, have also been made in wood.

On the Great Western Railway a considerable number of the bridges are now of wood.

All were originally of wood, and when renewals began to be necessary a few years ago, some of the heavier bridges were renewed in iron, but latterly all renewals have been made in wood, and it is understood that the Company intends all renewals that will be required in future of their bridges of wood and not of iron. That Company is also now making a cross line from Glencoe to the Niagara River, a distance of about

150 miles, over which they intend to pass the great bulk of their heavy passenger and freight traffic; upon this cross line they are erecting all their bridges of wood and laying steel rails, they state that they do this because it is the most economical arrangement, and that when any of the bridges require renewal they can be renewed in iron, if it should then be considered desirable to do so.

There are a considerable number of wooden bridges also on the Grand Trunk Railway, and no renewals of bridges on the Grand Trunk for the last ten years have been made in anything except wood, that policy will be continued by the Grand Trunk Company.

There are wooden bridges on the Grand Trunk Railway for about 300 miles of its line.

The undersigned has no doubt whatever that the proper course to adopt is to build the bridges on the Intercolonial Railway of wood, by which both economy and time will be secured, and that hereafter when these bridges, twelve or fifteen years hence, begin to require renewals, they can, if thought desirable, then be renewed in iron, the Railway affording the means of transporting the material to the spot without difficulty, delay or confusion.

(Signed,) C. J. BRYDGES.

Montreal, 23rd September, 1870.

No. 9.

Sandford Fleming to Sir John A. Macdonald.

INTERCOLONIAL RAILWAY,
OFFICE OF THE CHIEF ENGINEER,
OTTAWA, October 18th, 1870.

SIR,—Referring to the letter which I had the honor to address you on the 26th July last on the subject of the Intercolonial Railway bridges, I felt anxious to know if the Government had come to any decision in the matter, and accordingly made enquiries since my arrival in Ottawa a few days ago. I have learned from the Honorable the President of the Council, that the consideration of the subject is not finally closed, but that considerable difficulty and expense is apprehended by the Government in making the proposed change from wood to iron in consequence of certain representations which have been made by one of the Commissioners. The President of the Council was good enough at the same time to hand for my perusal a memorandum on the subject, dated 23rd September last, drawn up and submitted by Mr. C. J. Brydges, one of the Commissioners. I have looked over this document, and I find that one or two points only require to be noticed. I now, with your permission, desire to refer to them briefly.

Before doing so, however, I desire to remind you that when dealing with this question under a generally received impression that iron bridges would cost about double that of wood, I conclusively demonstrated, as a pure matter of economy, that they should be constructed of iron, and strongly urged that policy on the Government. Subsequently the Commissioners very properly adopted my views in relation to six of the most important bridges, and a careful detail examination of the whole subject, in order to prepare an accurate return for the House of Commons, has proved that the whole of the bridges may be erected of iron with scarcely any addition to the first cost over that required for structures of perishable materials. With these facts in my possession and in view of the important question of security to life and property for all time to come, it would really be criminal on my part not to urge by every means in my power the adoption of the permanent structures.

1. With regard to the question of casualties from fire on existing railways, I doubt if any record is kept of the number of bridges destroyed, or the number of times they catch fire. It is well known to be the established policy of railway managers to conceal as much as possible all accidents, and this policy is justified on the ground that to publish everything that occurred in the way of accidents, or escapes

from accidents, would only engender a feeling of insecurity in the mind of the travelling public without doing any good. Be this as it may, I have not at my hand any statistics to show the proportion of wooden bridges injured or destroyed during past years; but I have no difficulty in referring to the testimony of my own senses during the very last trip I made over that portion of the Grand Trunk where wooden bridges prevail, viz., between Portland and Richmond. On this section of this railway within a distance of about 150 miles, two wooden bridges had very recently been totally destroyed, one near Windsor Station, not ten miles from Richmond, the other at Richardson's Mills, a few miles from Island Pond; any one may see what has occurred if by chance they look out of the car windows, the trains are still passed over the Rivers on temporary staging, and the marks of fire still remain on the banks. On enquiry I learned that notwithstanding the employment of watchmen to look after and protect them, the wooden bridges on this section of the Grand Trunk are continually catching fire. It is the duty of the watchman to make personal examination of the bridge under his charge after each train has passed, and put out any sparks that may have lodge in the timbers, but notwithstanding these extraordinary expensive and necessary precautions it appears that on this section referred to alone, and within the past two or three months only, no less than two wooden bridges have been totally destroyed. These fires have been caused it is supposed by sparks from the engines, unseen by the watchman and left to smoulder until fanned into a flame, thus illustrating an element of danger not prominently noticed in my previous letters, but however caused, these fires and the constant expense in attempting to guard against them, show very forcibly the danger and mistaken economy of employing structures made of combustible materials on a line of railway. In the case of the burning of the bridge at Richardson's Mills, it is reported that the fire spread to the mill property adjoining destroying everything, and the result is an enormous claim, some say from \$40,000 to \$50,000 against the Railway Company for damages.

Mr. Brydges gives to the Government most positive testimony respecting the entire immunity of wooden bridges from danger during a period of eighteen years, the length of his experience as Chief Manager of Railways in Canada; it would have been only candid on his part had he alluded in some way for the information of the Government to what I have here mentioned.

No one knows better than the officers in charge of railways with perishable structures, that the risk to life and property from one cause or another is always great, the above are only two instances which came to my knowledge casually the other day, and I mention them as illustrations. Since Mr. Brydges' statement was put in my hands two days ago, I have taken the trouble to ascertain the exact days upon which these bridges were consumed. It appears that the Windsor bridge was destroyed on the 26th July; the bridge and other property at Richardson's Mills, on the 6th of the same month. Mr. Brydges' statement is dated the 23rd September. The two accidents referred to may possibly, at the time Mr. Brydges wrote, have escaped his memory, but if he forgot what occurred so recently, almost under his own eye, it is difficult to conceive how he can remember all that has occurred during so long a period as eighteen years.

I do not wish to go over all the arguments against the use of wooden bridges on the Intercolonial Railway again, but I think I should here draw attention to the fact that owing to the description of timber covering the face of the country in the Lower Provinces, fires in the wood much more frequently occur than elsewhere where the circumstances are different; in Ontario and much of Quebec, where existing railways run, the adjoining country is generally cleared, and in the case of hardwood forests, where they exist, fires are seldom known, and they never carry with them such widespread destruction to everything combustible as in the wilderness country through which so much of the Intercolonial Railway is now being constructed. The Commissioners could not fail to see during their last trip scores of miles on both sides of the lines blackened by fires; the road over which they passed had a great many of its bridges destroyed, and had it been the railway, its bridges, if of timber, would have shared the same fate; I am satisfied that nothing whatever could have saved them.

2. Mr. Brydges endeavors to show that there would be a great deal of difficulty with the Contractors in substituting iron for wooden spans. There was no difficulty whatever experienced in making the change in the six cases, which the Commissioners have already decided should be of iron, and it certainly does not appear very clear that there would be much greater difficulty now with regard to the whole, more especially as nearly all the contracts since let contain a special clause reserving power to the Commissioners to make the change.

3. Mr. Brydges calls in question the accuracy of the figures I have submitted respecting the quantities of masonry in the piers and abutments of the bridges to be built on the line of the Intercolonial Railway. I can only say in reply, that the quantities have been most carefully computed in detail, from the very best data to be had, by the most accurate and painstaking Engineer on my staff; this gentleman again assures me that they are correct, and I have so much confidence in him, that I challenge the very closest scrutiny; I believe them to be as reliable as they can possibly be, and I would not venture to present them as such if any doubt existed in my own mind.

4. Mr. Brydges states that while my estimates for wooden superstructures is about correct, I have placed the probable cost of superstructures of iron much too low; he also states that iron bridges could not be secured in time for the laying of the rails and ballasting. I only desire to have an opportunity afforded me of satisfying the Government on this point. I know perfectly well that I could find parties with a reputation above all question, who would undertake to furnish and erect the very best description of iron bridges now made, over the whole line *for less than my estimate*, and without causing any serious, or any delay at all, either to the laying of the rails, the ballasting, or any other work whatever.

I now come to another matter which I may be excused for bringing up at this opportunity. I am directed to furnish to the Contractors, immediately, plans of wooden superstructure for the bridges at Rivière du Loup and Isle Verte. These plans are prepared, and it is my duty to obey; before mailing, however, I beg to make a final and respectful appeal against the taking of an irrevocable step which must, in the estimation of every one lower and degrade the character of the works on this important national undertaking.

In August last, I wrote to the Commissioners suggesting that until the Government had an opportunity of considering the whole subject, part of the masonry of these bridges should be suspended, so that the saving in masonry due to the employment of iron superstructures might be effected. A suspension was not, however, authorized, the masonry is now well advanced, and it is now too late to effect any saving in a change from wood to iron. I am prepared, however, to make very considerable personal sacrifices rather than see a single perishable bridge on this line of railway; a line with which I have been so long connected, and in the perfect construction of which I take a great and pardonable pride. If the Government will allow these bridges to be of iron instead of wood, I will consent to pay half the difference in cost, if any, out of my own salary, and I shall guarantee that the tracklaying and ballasting shall not be interrupted or delayed in any way.

I now very respectfully beg for authority to order spans of iron instead of wood for Rivière du Loup and Isle Verte on these conditions.

I have the honor to be, Sir,

Your obedient servant,

SANDFORD FLEMING,

Chief Engineer.

To the Hon. Sir John A. Macdonald, K. C. B.,
Minister of Justice, &c.

No. 10.

Copy of a Report of the Commissioners of the Intercolonial Railway to the Honorable the Privy Council of date 16th January, 1871.

The Commissioners for the construction of the Intercolonial Railway beg to report to the Governor in Council, upon the question of the superstructure of the bridges on the line.

A report from the Chief Engineer is appended, from which it appears that the larger bridges can be constructed of iron, at a cost which will not greatly exceed that for wood, taking into account the reduction, which in some cases, may be made in the masonry.

Considering that steel rails are to be laid upon the whole line, and that it is desirable that all the work should, as far as possible, be of the most permanent character, the Commissioners recommend that all spans of bridges, of more than sixty feet openings, should be constructed of iron, provided that such changes will not delay the completion of the works, and that such arrangements can be made with the several contractors as will not materially enhance the cost.

(Signed,)

A. WALSH,
ED. B. CHANDLER,
C. J. BRYDGES,
A. McLELAN,
Commissioners.

No. 11.

Copy of a Report of a Committee of the Honorable the Privy Council, approved by His Excellency the Governor General in Council on the 19th January, 1871.

14th & 16th Jan. 1871. The Committee of Council after carefully considering the report of the Intercolonial Railway Commissioners and Chief Engineer of that Railway, shewing the economy of adopting steel rails, notwithstanding the greater cost in the first instance, and having considered the report of the Commissioners of the 16th Jan- uary, 1871. the 13th January, inst., recommending the acceptance of the tenders of the Ebb Vale Co., at £11 stg. per ton; the Barrow Co., at £11 5s. stg. They respectfully recommend the adoption of that report, leaving to the Commissioners to make if practicable, a better arrangement with respect to freight.

The Committee having thus, for the reasons given in the several reports referred to, come to the conclusion to recommend the use of steel rails for the Intercolonial Railway, further advise that, with a view to render all the more important works and structures connected with the roadway as indestructible as possible, the Commissioners be authorized to build iron bridges instead of wooden bridges in cases where the span is over sixty feet, whenever—

1st. The Contractors assent, and the change can be made without increase of cost or payment of indemnity.

2nd. Where there is no material delay caused by the change.

3rd. Whenever the additional cost of the bridges will not exceed the estimate of the Chief Engineer, already submitted to Council.

They further advise that the iron bridges be put up to public tender.

Certified.

W. A. HILSWORTH,
Clerk, Privy Council.

No. 12.

Letter from the Chairman of the Commissioners to the Chief Engineer.

(This document incloses the Order in Council of 19th January, 1871, and directs the Chief Engineer to carry it into effect.)

No. 13.

The Chief Engineer to the Chairman of the Commissioners.

INTERCOLONIAL RAILWAY,
OFFICE OF THE CHIEF ENGINEER,
OTTAWA, January 21st, 1871.

DEAR SIR,—I have your letter of this date in reference to iron bridges, and will be happy to attend to the contents thereof. The first and third conditions attached to the Order in Council, approved 19th January last, are admittedly ambiguous, and they formed the subject of the conversation we had with the Ministers of Public Works and Agriculture at the office of the former; they were also discussed with the President of the Council at his office, and I understood all three to say that the Council intended by the first condition simply to mean that before the changes from wood to iron were finally determined on, arrangements should be made with each Contractor of such a nature that no claims for indemnity or for extras should be established by them by reason of the change. In fact, to make arrangements in every case similar to that intended by the special clause bearing on the question which was added to some of the contracts. By the third condition, that the cost of iron superstructure should be within or not materially exceed my estimate of the same—this being the substance of the verbal explanations and directions given by the Ministers referred to. I desire to put it on record for my own guidance and for correction, if I should be under any misapprehension.

Yours very truly,
(Signed,) SANDFORD FLEMING,
Chief Engineer.

A. Walsh, Esq.,
Chairman, &c.,
Ottawa.

No. 14.

The Chief Engineer to the Secretary of the Commissioners.

INTERCOLONIAL RAILWAY,
OFFICE OF THE CHIEF ENGINEER,
OTTAWA, May 5th, 1871.

C. S. Ross, Esq.,
Secretary.

SIR,—Referring to your letter of January 20th, as well as to a letter of the Chairman of the same date and my reply thereto, dated 21st January, all on the subject of bridges, and the substitution of iron for wood in the superstructure thereof.

This correspondence resulted from an Order in Council dated 19th January, which, as explained by the Minister of Public Works and other members of the Government, was intended to mean substantially as follows:—That all bridges over sixty feet span be made of iron instead of wood, provided the change can be effected without establishing claims for indemnity or extras by contractors, and provided also the iron spans can be erected at prices within or not greatly exceeding my estimate for the same submitted to Council. The duty of giving effect to the Order in Council by the Chairman's letter devolved upon me.

In order to set at rest the question of claims for extras or indemnity by contractors, I have had a paper, worded as follows, executed by all or nearly all the Contractors on the Line:—

"We, the undersigned Contractors for sections of the Intercolonial Railway, "having been advised that the Government is anxious to substitute iron for wooden "bridges upon said Railway, provided such substitution can be effected without "payment of indemnity or additional cost, and being desirous that this great national "undertaking (in the construction of which we take a just pride) shall be as perma- "nent and indestructible as possible, we hereby severally concur in the substitution "of iron for wooden spans upon our respective sections, in every instance where the "Government and Commissioners may consider the same desirable on condition that

"the Commissioners furnish and erect such spans of iron free of cost to us; and inasmuch as such substitution would be a saving to us of the cost of erecting the spans of timber, and in some instances it would also be a saving in the quantity of masonry in the abutments and piers of bridges. We hereby consent to a deduction from the amount payable to us at the close of the contract, equal to the value of the said wooden spans and masonry saved to us by such substitution, the same being calculated at the rates given in the Schedules to our respective contracts, and further we shall not prefer any claims for indemnity on account of said substitution of iron for wooden bridges."

This paper still wants one signature to complete it. I shall transmit it to you as soon as I have an opportunity of procuring this signature, in this I anticipate no difficulty as the contract of the contractor contains a clause, especially inserted, to the same effect as the paper above referred to.

In order to satisfy the Government with regard to the cost of the iron bridges, I sent the following circular along with the specification and other documents printed for the use and information of parties tendering.

INTERCOLONIAL RAILWAY,
CHIEF ENGINEER'S OFFICE
OTTAWA, January 21st, 1871.

MEMORANDUM.

To Iron Bridge-Builders.

"The total number of spans on this line of Railway will probably be as follows:

16 spans of 200 feet.		
61	"	100 "
10	"	80 "
19	"	60 "
22	"	50 "
21	"	40 "
5	"	30 "
2	"	24 "

"The Government of Canada and the Railway Commissioners have decided to make the sixteen 200 feet spans and twenty-one of the 100 feet spans above mentioned of iron; they have also determined to have the remainder of the 100 feet spans and the eighty feet spans of iron, provided the cost does not exceed the estimates laid before them."

"The undersigned is not authorized to ask for tenders for any spans under 80 feet, but he advocates the adoption of iron bridges throughout the whole line, and will be glad (in order that the Government may be placed in possession of full information on the subject) if parties tendering will give the prices at which they would be prepared to furnish all the various spans.

(Signed,) "SANDFORD FLEMING,
"Chief Engineer."

With regard to the cost of erecting the spans of iron, I find in looking over the tenders for supplying and erecting all bridges of 100 feet and under, the lowest appears to be one from the Fairbairn Engineering Company, of Manchester, England. The following is a comparison of the Fairbairn prices with my own estimate.

Fairbairn Engineering Co.'s Prices.			Chief Engineer's Estimate.		
No. and Length of Spans.	Rate.	Amount.	No. and Length of Spans.	Rate.	Amount.
	\$ cts.	\$ cts.		\$ cts.	\$ cts.
61 Spans of 100 feet :—			61 Spans of 100 feet.....	5,600 00	341,600 00
25 Through Spans.....	5,941 00	148,525 00			
36 Deck ".....	4,719 00	169,524 00			
		318,049 00			
10 Spans of 80 feet :—			10 Spans of 80 feet.....	3,750 00	37,500 00
8 Through Bridges.....	3,670 00	29,360 00			
2 Deck ".....	2,834 00	5,668 00			
		35,028 00			
19 Spans of 60 feet :—			19 Spans of 60 feet.....	2,200 00	41,800 00
1 Through Bridge.....	2,649 00	2,649 00			
18 Deck ".....	1,919 00	34,542 00			
		37,191 00			
22 Spans of 50 feet.....	1,383 00	30,426 00	22 Spans of 50 feet.....	1,600 00	35,200 00
21 Spans of 40 ".....	1,023 00	21,483 00	21 Spans of 40 feet.....	1,200 00	25,200 00
5 Spans of 30 ".....	463 00	2,315 00	5 Spans of 30 feet.....	600 00	30,000 00
2 Spans of 24 ".....	370 00	740 00	2 Spans of 24 feet.....	360 00	720 00
		\$445,232 00			\$485,020 00

The Fairbairn Engineering Company of Manchester, is one of the first and oldest establishments in existence, they will without any doubt carry out in a satisfactory manner whatever they undertake, and as this firm proposes to erect in place the various bridges considerably under my estimate, the remaining condition of the Order in Council is fully met, and the substitution of iron for wood may therefore be considered authorized by the Government.

While this appears perfectly clear with regard to all bridges over 60 feet span, the Order in Council of 19th January does not go so far as to sanction the substitution of iron for wood for spans of 60 feet and under.

The information which I am now enabled to submit is, however, of such a nature that the Government will have no difficulty in arriving at a final and satisfactory decision with respect to the substitution of iron for wood for all the lesser as well as for the larger spans on the line.

The paper which the contractors have signed gives their consent to the substitution of iron for wood in the small as well as in the larger spans, and relinquishes on their part all claims for indemnity or extras by reason of the substitution; the paper further gives their consent to deduction from their contract sums of the value of the wooden spans and masonry saved, and in every case it clearly and exactly defines the rates and prices fixed at which the deductions are to be calculated.

The tenders now received give the prices at which reliable builders are prepared to erect, in their proper places on the line of railway, all the iron bridges small as well as large.

We are thus furnished with the exact means of ascertaining the cost of erecting complete the bridge structures with spans of wood or with spans of iron.

I have asked my assistant, Mr. Forrest, to make calculations shewing the cost separately of each bridge structure of sixty feet span and under on the line. Mr. Forrest's calculations are herewith furnished in detail, and if they are correct, and I

do not at all question their accuracy, all the bridges of sixty feet and under can actually be built with spans of iron for considerably less than with spans of wood.

These calculations clearly establish the fact, that while all the smaller bridge structures (including masonry) would cost \$289,897, if built with wooden spans, they would only cost \$331,996, if built with iron spans, and by the adoption of the latter an actual saving in the first cost would be effected of \$57,901.

I should state that the prices of the iron spans are those given in the tender of the Fairbairn Engineering Company, *without duty*; if duty is collected at the rate of 15 per cent., it would amount to about \$8,257. The cost of the iron spans would be chargeable with that amount, and the comparison would stand thus:—

	Bridges with spans of		Difference.
	Timber.	Iron.	
	\$	\$	\$
1. Total cost of masonry calculated at Contractors' prices in each case	289,953	248,159	41,794
2. Total cost of superstructure, comprising 19 spans of 60 feet, 19 spans of 50 feet, 18 spans of 40 feet, five spans of 30 feet, one span of 24 feet, calculated at Contractors' prices in the case of timber spans, and at the Fairbairn's tender prices in the case of iron spans, and in the latter case, 15 per cent. duty on the F.O.B. prices is added.....	99,944	92,094	7,850
Totals.....	389,897	340,253	49,644

Shewing a net saving in first cost, after paying duty on iron spans, of \$49,644.

The substitution of iron for wood in the small spans would reduce the quantity of masonry to be built about 3,864 cubic yards, and by lessening the work to be executed would facilitate the construction of the line.

I am, Sir,
Your obedient servant,
(Signed,) SANDFORD FLEMING,
Chief Engineer.

No. 15.

The Chief Engineer to the Secretary of the Commissioners.

INTERCOLONIAL RAILWAY,
OFFICE OF THE CHIEF ENGINEER,
OTTAWA, May 10, 1871.

C. S. Ross, Esq.,
Secretary.

SIR,—As requested by the Commissioners, I have made a careful examination of all the tenders and plans recently received for the supply and erection of iron bridges, and I now have to report.

I find that 36 different establishments in England and in the United States, have tendered for the bridges, and the tenders embrace a great variety of forms of construction for all the various spans from 200 feet down.

Some parties give prices for the construction of certain of the bridges and their delivery F. O. B. near the place of manufacture, others for the furnishing and erection on the line of a certain number of spans. Some firms give prices for both delivery near the place of manufacture and erection of a limited number of spans, and five establishments tender for the manufacture, the delivery and the erection complete in place of every bridge on the line.

The following estimates are prepared for the purpose of comparing the five tenders for erecting all the bridges under one contract:—

TENDER No. 1.—CAMPBELL, JOHNSTON & Co., LONDON, ENGLAND.

	Rate.	Amount.
	\$	\$
16 spans of 200 feet		423,316
61 do 100 do	6,287	383,507
10 do 80 do	4,391	43,910
19 do 60 do	2,255	42,895
22 do 50 do	1,544	33,968
21 do 40 do	1,040	21,840
5 do 30 do	693	3,465
2 do 24 do	460	920
Total.....		\$953,771

TENDER No. 14.—JOHN WALKER, LONDON, ONT.

16 spans of 200 feet		416,688
61 do 100 do	6,387	389,607
10 do 80 do	5,113	51,130
19 do 60 do	2,067	39,273
22 do 50 do	1,443	31,746
21 do 40 do	870	18,270
5 do 30 do	575	2,575
2 do 24 do	328	656
Total.....		\$949,945

TENDER No. 19.—CLARKE, REEVES & Co, PHILADELPHIA.

16 spans of 200 feet		309,352
61 do 100 do	5,097	310,917
10 do 80 do	4,088	40,880
19 do 60 do	2,928	55,632
22 do 50 do	2,356	51,832
21 do 40 do	2,014	42,294
5 do 30 do	(say) 1,926	4,630
2 do 24 do	(say) 740	\$1,480
Total.....		\$817,017

TENDER No. 22.—FAIRBAIRN ENGINEERING Co., MANCHESTER.

	Rate.	Amount.
	\$	\$
16 spans of 200 feet.....		415,625
61 do 100 do	4,709	287,249
10 do 80 do	2,834	28,840
19 do 60 do	1,919	36,461
22 do 50 do	1,383	30,426
21 do 40 do	1,023	21,483
5 do 30 do	463	2,315
2 do 24 do	370	740
Total		\$822,639

TENDER No. A.—R. JAS. REEKIE, MONTREAL.

16 spans of 200 feet.....		385,925
61 do 100 do	7,425	452,925
10 do 80 do	4,500	45,000
19 do 60 do	3,000	57,000
22 do 50 do	2,100	46,200
21 do 40 do	1,700	35,700
5 do 30 do	800	4,000
2 do 24 do	620	1,240
Total		\$1,027,990

With respect to the question of cost, it appears from the foregoing that these tenders stand in the following order:—

Tender No. 19.—Clarke, Reeves & Co.....	\$ 817,017
“ 22.—Fairbairn Engineering Company.....	822,636
“ 14.—John Walker.....	949,945
“ 1.—Campbell, Johnston & Co.....	953,771
“ A.—R. Jas. Reekie.....	1,027,990

I have very carefully examined the plans furnished by these parties, with the view of forming an opinion as to the most suitable, taking everything into consideration, and in this respect, I think they stand in the following order:—

- 1st, The Fairbairn Engineering Company, Tender No. 22.
- 2nd, Campbell, Johnston & Co., “ 1.
- 3rd, John Walker, “ 14.
- 4th, R. Jas. Reekie, “ A.
- 5th, Clarke, Reeves & Co., “ 19.

These five tenders are for the whole bridges on the line. I shall now refer to the other tenders, giving a separate comparison for all the different spans, and as the greatest difficulty has been experienced in comparing the tenders and plans for the 200 feet spans, and as these are the most important, I shall notice them especially; it will, however, be convenient to deal with the smaller spans first.

In the following I have thrown out tender No. 17, for the reason that no plans have been furnished to indicate the character of bridge proposed to be furnished by the party tendering.

In the first place I shall furnish lists of the tenders for delivery of the bridges in parts, free on board ship, at the nearest port to the place of manufacture.

These tenders I have arranged in their proper order according to prices.

SPANS OF 100 FEET; TRACK ON TOP.

No.	Number of Tender.	Name.	Port of Delivery.	Price per Span, F.O.B.
				\$ cts.
1	12	Westwood, Baillie & Co.....	London, England	2,608 00
2	10	Pease, Hutchinson & Co.....	Newcastle-on-Tyne	2,612 00
3	34	Ashbury Iron Co.....	Liverpool, England.....	2,654 00
4	19	Clarke, Reeves & Co.....	Philadelphia, United States	3,069 00
5	22	Fairbairn Engineering Co.	Liverpool, England.....	3,214 00
6	15	Thomas Brassey & Co.....	do	3,332 00
7	20	A. Becker	Any port in Great Britain.....	3,710 00
8	7	Knight, Howard & Co.....	Middleboro'-on-Tees	3,770 00
9	33	John Cockerill	Antwerp, Belgium	4,160 00
10	14	John Walker	Glasgow	4,185 00
11	9	Hopkins, Gilkes & Co.....	Tees River	4,208 00
12	25	E. A. Jones.....	do	4,208 00
13	8	Palmer Iron Co.....	On the Tyne.....	4,602 00
14	21	P. & W. McLellan	Glasgow	5,070 00
15	31	Watson Manufacturing Co.....	New York	5,670 00
16	18	Detroit Iron Works	Montreal	5,865 00
17	30	American Bridge Co	Chicago	6,200 00

SPANS OF 100 FEET; TRACK ON BOTTOM.

1	10	Pease, Hutchinson & Co.....	Newcastle-on-Tyne	3,375 00
2	32	Blodgett & Curry.....	Shediac, N.B.	3,950 00
3	19	Clarke, Reeves & Co.....	Philadelphia	3,869 00
4	22	Fairbairn Engineering Co.....	Liverpool, England.....	4,237 00
5	7	Kreeft, Howard & Co.....	Middleboro'-on-Tees	4,602 00
6	20	A. Becker	Any port in Great Britain.....	4,725 00
7	31	Watson Manufacturing Co.....	New York	5,940 00
8	18	Detroit Iron Works	Montreal	6,100 00
9	21	P. & W. McLellan.....	Glasgow	6,190 00
10	30	American Bridge Co.....	Chicago.....	6,700 00

SPANS OF 80 FEET; TRACK ON TOP.

1	22	Fairbairn Engineering Co.....	Liverpool, England	1,860 00
2	34	Ashbury Iron Co.....	do	2,227 00
3	15	Thomas Brassey	do	2,265 00
4	12	Westwood, Baillie & Co.....	London, England.....	2,299 00
5	19	Clarke, Reeves & Co.....	Philadelphia	2,400 00
6	20	A. Becker	Any port in Great Britain.....	2,610 00
7	9	Hopkins, Gilkes & Co.....	Tees River	2,792 00
8	25	E. A. Jones	do	2,792 00
9	53	John Cockerill.....	Antwerp, Belgium.....	3,140 00
10	21	P. & W. McLellan	Glasgow	3,214 00
11	14	John Walker	do	3,349 00
12	8	Palmer Iron Co.....	On the Tyne.....	3,380 00
13	18	Detroit Iron Works	Montreal	3,860 00
14	30	American Bridge Co.....	Chicago	4,150 00
15	31	Watson Manufacturing Co.....	New York	4,300 00

SPANS OF 80 FEET; TRACK ON BOTTOM.

No.	Number of Tender.	Name.	Port of Delivery.	Price per Span. F.O.B.
				\$ cts.
1	10	Pease, Hutchinson & Co.....	Newcastle on Tyne	2,537 00
2	22	Fairbairn Engineering Co.....	Liverpool, England.....	2,557 00
3	15	Thomas Brassey	do	2,693 00
4	32	Blodgett & Curry.....	Shediac, New Brunswick.....	2,850 00
5	7	Kreeft, Howard & Co.....	Middleboro'-on-Tees	3,092 00
6	19	Clarke, Reeves & Co.....	Philadelphia	3,186 00
7	20	A. Becker	Any port in Great Britain.....	3,600 00
8	21	P. & W. McLellan	Glasgow	3,730 00
9	18	Detroit Iron Works	Montreal	4,000 00
10	30	American Bridge Co	Chicago.....	4,300 00
11	31	Watson Manufacturing Co.....	New York.....	4,558 00

SPANS OF 60 FEET: TRACK ON TOP.

1	22	Fairbairn Engineering Co.....	Liverpool, England.....	1,315 00
2	12	Westwood, Baillie & Co.....	London, do	1,315 00
3	14	John Walker.....	Glasgow.....	1,354 00
4	15	Thomas Brassey.....	Liverpool, England.....	1,364 00
5	34	Ashburn Iron Co.....	do do	1,431 00
6	19	Clarke, Reeves & Co.....	Philadelphia.....	1,736 00
7	9	Hopkins, Gilkes & Co.....	Tees River.....	1,842 00
8	25	E. A Jones.....	do	1,842 00
9	20	A. Becker.....	Any port in Great Britain.....	1,875 00
10	31	Watson Manufacturing Co.....	New York.....	1,980 00
11	33	John Cockerill.....	Antwerp, Belgium.....	1,987 00
12	30	American Bridge Co.....	Chicago.....	2,100 00
13	21	R. & W. McLellan.....	Glasgow.....	2,240 00
14	8	Palmer Iron Co.....	On the Tyne.....	2,347 00

SPANS OF 60 FEET; TRACK ON BOTTOM.

1	10	Pease, Hutchinson & Co.....	Newcastle-on-Tyne	1,463 00
2	32	Blodgett & Curry.....	Shediac, New Brunswick.....	1,475 00
3	15	Thos. Brassey.....	Liverpool, England.....	1,812 00
4	22	Fairbairn Engineering Co.....	do do	1,826 00
5	7	Kreeft, Howard & Co.....	Middleboro'-on-Tees.	1,885 00
6	31	Watson Manufacturing Co.....	New York.....	2,211 00
7	19	Clarke, Reeves & Co.....	Philadelphia	2,264 00
8	20	A. Becker.....	Any port in Great Britain.....	2,350 00
9	30	American Bridge Co.....	Chicago.....	2,450 00
10	21	P. & W. McLellan.....	Glasgow	2,644 00

SPANS OF 50 FEET.

1	22	Fairbairn Engineering Co.....	Liverpool, England.....	886 00
2	14	John Walker.....	Glasgow	945 00
3	12	Westwood, Baillie & Co.....	London, England.....	950 00
4	10	Pease, Hutchinson & Co.....	Newcastle-on-Tyne.....	1,125 00
5	34	Aashbury Iron Co.....	Liverpool, England.....	1,142 00
6	32	Blodgett & Curry.....	Shediac, N. B.....	1,150 00

SPANS OF 50 FEET.—*Concluded.*

No.	Number of Tender.	Name.	Port of Delivery.	Price per Span, F.O.B.
				\$ cts.
7	9	Hopkins, Gilkes & Co.....	Tees River.....	1,241 00
8	25	E. A. Jones.....	do	1,241 00
9	19	Clarke, Reeves & Co.....	Philadelphia	1,350 00
10	15	Thomas Brassey.....	Liverpool, England.....	1,383 00
11	7	Kreeft, Howard & Co.....	Middleboro'-on-Tees	1,432 00
12	30	American Bridge Co.....	Chicago	1,490 00
13	33	John Cockerill.....	Antwerp, Belgium.....	1,502 00
14	31	Watson Manufacturing Co.....	New York.....	1,595 00
15	21	P. & W. McKellar.....	Glasgow	1,719 00
16	8	Palmer Iron Co.....	On the Tyne.....	1,812 00

SPANS OF 40 FEET.

1	10	Pease, Hutchinson & Co.....	Newcastle-on-Tyne	477 00
2	14	John Walker.....	Glasgow	570 00
3	12	Westwood, Baillie & Co.....	London, England.....	584 00
4	22	Fairbairn Engineering Co.....	Liverpool, England.....	633 00
5	32	Blodgett & Curry.....	Shediac, N. B.....	750 00
6	23	John Cockerill.....	Antwerp, Belgium.....	840 00
7	34	Ashbury Iron Co.....	Liverpool, England.....	856 00
8	20	A. Becker.....	Any port in Great Britain.....	1,000 00
9	9	Hopkins, Gilkes & Co.....	Tees River.....	1,023 00
10	25	E. A. Jones.....	do	1,023 00
11	19	Clarke, Reeves & Co.....	Philadelphia	1,050 00
12	7	Kreeft, Howard & Co.....	Middleboro'-on-Tees	1,057 00
13	15	Thomas Brassey.....	Liverpool, England.....	1,144 00
14	31	Watson Manufacturing Co.....	New York.....	1,237 50
15	30	American Bridge Co.....	Chicago.....	1,300 00
16	21	P. & W. McLellan.....	Glasgow	1,320 00
17	8	Palmer Iron Co.....	On the Tyne.....	1,461 00

SPANS OF 30 FEET

1	10	Pease, Hutchinson & Co.....	Newcastle-on-Tyne	307 00
2	22	Fairbairn Engineering Co.....	Liverpool, England.....	316 00
3	14	John Walker.....	Glasgow.....	340 00
4	20	A. Becker.....	Any port in Great Britain.....	360 00
5	12	Westwood, Baillie & Co.....	London, England.....	365 00
6	32	Blodgett & Curry.....	Shediac, N. B.....	425 00
7	34	Ashbury Iron Co.....	Liverpool, England.....	555 00
8	15	Thomas Brassey.....	Liverpool, England.....	519 00
9	33	John Cockerill	Antwerp, Belgium.....	600 00
10	7	Kreeft, Howard & Co.....	Middleboro'-on-Tees	643 00
11	9	Hopkins, Gillies & Co.....	Tees River.....	730 00
12	25	E. A. Jones.....	do	730 00
13	31	Watson Manufacturing Co.....	New York.....	850 00
14	30	American Bridge Co.....	Chicago.....	880 00
15	21	P. & W. McLellan.....	Glasgow.....	925 00
16	8	Palmer Iron Co.....	On the Tyne.....	1,217 00

SPANS OF 24 FEET.

No.	Number of Tender.	Name.	Port of Delivery.	Price per Span, F.O.B.
				\$ cts.
1	14	John Walker	Glasgow	215 00
2	12	Westwood, Baillie & Co.....	London, England.....	219 00
3	10	Pease, Hutchinson & Co.....	Newcastle on Tyne.....	239 00
4	20	A. Becker	Any port in Great Britain	250 00
5	22	Fairbairn Engineering Co.....	Liverpool, England.....	253 00
6	34	Ashbury Iron Co.....	do	346 50
7	32	Blodgett & Curry.....	Shediac, New Brunswick.....	380 00
8	15	Thomas Brassey	Liverpool, England.....	399 00
9	33	John Cockerill	Antwerp, Belgium	400 00
10	9	Hopkins, Gilkes & Co.....	Tees River.....	438 00
11	25	E. A. Jones.....	do	438 00
12	7	Kreeft, Howard & Co.....	Middleboro'-on-Tees	526 00
13	31	Watson, Manufacturing Co.....	New York	672 00
14	21	P. & W. McLellan	Glasgow	750 00
15	8	Palmer Iron Co.....	On the Tyne.....	877 00

In comparing tenders for supply and erection it would be of little use to take spans separately, as there is no possibility that the parties tendering would be prepared to send out men and implements for putting in place a single bridge or a limited number of bridges unless at an advance on their tender prices.

I think the best way is to group all the smaller spans together and money them out at the rates given in each tender. There is a difference between the cost of a bridge with the track on the top and one with the track on the bottom, but as only one tender gives the price for both in all the different spans, I am obliged, in order to place all the tenders on the same footing in the following comparison, to overlook the spans with the track on bottom and assume all to have the track on top. This will not materially affect the total amounts, and it is the only way in which a proper comparison can be made.

SPANS of 100 feet and under—*Erection included.*

TENDER No. 1.—CAMPBELL, JOHNSTON & Co. LONDON, ENGLAND.

	Rate.	Amount.
61 Spans of 100 feet	6,287 00	383,507 00
10 do 80 do	4,391 00	43,910 00
19 do 60 do	2,255 00	42,845 00
22 do 50 do	1,544 00	33,968 00
21 do 40 do	1,040 00	21,840 00
5 do 30 do	693 00	3,465 00
2 do 24 do	460 00	920 00
Total.....		\$530,455 00

TENDER No. 14.—JOHN WALKER, LONDON, ONTARIO.

	Rate.	Amount.
61 Spans of 100 feet	6,387 00	389,607 00
10 do 80 do	5,113 00	51,130 00
19 do 60 do	2,067 00	39,273 00
22 do 50 do	1,443 00	31,746 00
21 do 40 do	870 00	18,270 00
5 do 30 do	515 00	2,575 00
2 do 24 do	328 00	656 00
Total.....		\$533,257 00

TENDER No. 19.—CLARKE, REEVES & CO., PHILADELPHIA.

61 spans of 100 feet	5,097 00	310,917 00
10 do 80 do	4,088 00	40,880 00
19 do 60 do	2,928 00	55,632 00
22 do 50 do	2,356 00	51,832 00
21 do 40 do	2,014 00	42,294 00
5 do 30 do (say)	1,926 00	4,630 00
2 do 24 do (say)	740 00	1,480 00
Total.....		\$507,665 00

TENDER No. 22.—FAIRBAIRN ENGINEERING CO., MANCHESTER.

61 spans of 100 feet	4,709 00	287,249 00
10 do 80 do	2,834 00	28,340 00
19 do 60 do	1,919 00	36,461 00
22 do 50 do	1,383 00	30,426 00
21 do 40 do	1,023 00	21,483 00
5 do 30 do	463 00	2,315 00
2 do 24 do	370 00	740 00
Total		\$407,014 00

TENDER No. A.—R. JAS. REEKIE, MONTREAL.

61 spans of 100 feet	7,425 00	452,925 00
10 do 80 do	4,500 00	45,000 00
19 do 60 do	3,000 00	57,000 00
22 do 50 do	2,100 00	46,200 00
21 do 40 do	1,700 00	35,700 00
5 do 30 do	800 00	4,000 00
2 do 24 do	620 00	1,240 00
Total.....		\$642,665 00

The tenders for furnishing and erecting all the smaller spans, viz:—Those of 100 feet and under, appear from the foregoing to stand in the following order with respect to amount:—

Tender No. 22, The Fairbairn Engineering Company....	\$407,014
“ 19, Clarke, Reeves & Co.....	507,665
“ 1, Campbell, Johnston & Co.....	530,455
“ 14, John Walker.....	533,257
“ A, R. Jas. Reekie.....	642,065

In this case there can be no question as to No. 22 being the most eligible tender.

SPANS OF 200 FEET.

There are three bridges to have spans of 200 feet, namely, the Restigouche, five spans, the North-west Miramichi, five spans, and the South-west Miramichi, six spans, making sixteen spans in all.

The various plans of bridges submitted may be divided into two classes, which to distinguish them may be designated “Pin” and “Riveted” bridges.

The tenders for delivery free on board, of these sixteen spans come in the following order, beginning with the lowest.

No.	No. of Tender.		Pin.	Riveted.
			\$	\$
1	5	Darlington Iron Co., Liverpool.....		144,024
2	3	Patent Shaft Co., Liverpool or London.....	158,540	
3	6	Phoenix Engineering Works, Liverpool.....	163,496	
4	15	Thomas Brassey & Co., Liverpool.....		169,283
5	34	Ashbury Iron Co., Liverpool.....		183,314
6	26	Kellogg Bridge Co., Buffalo.....	213,248	
7	B	Boxall & Burpee, St. John, N. B.....		223,328
8	20	A. Becker, any port in Great Britain.....	223,680	
9	10	Pease, Hutchinson & Co., Newcastle-on-Tyne.....		229,348
10	4	Lewis & Stockwell, London.....		236,955
11	32	Blodgett & Curry, Shediac, N. B.....	238,500	
12	23	Chas. Macdonald, Philadelphia.....	242,080	
13	17	Thomas Evans, Liverpool.....		242,176
14	19	Clark, Reeves & Co., Philadelphia.....	243,852	
15	21	P. & W. McLellan, Glasgow.....		244,206
16	33	John Cockerill, Antwerp, Belgium.....		248,640
17	9	Hopkins, Gilkes & Co., Tees River.....		275,610
18	14	John Walker, Glasgow.....		276,720
19	22	Fairbairn Engineering Co., Manchester.....		289,940
20	12	Westwood, Baillie & Co., London.....		297,998
21	18	Detroit Bridge and Iron Works, Montreal.....	315,675	
22	31	Watson Manufacturing Co., New York.....	333,100	
23	29	McNairy & Claflen, Cleveland.....	350,060	
24	30	American Bridge Co., Chicago.....	387,160	

On carefully examining the plans, and investigating everything connected therewith, I am of opinion that the tender of Pease, Hutchinson & Co., of Newcastle, England, is the lowest that should be adopted.

The plans of all lower tenders are objectionable in their present form.

With regard to the tenders which include erection complete in place, I find they stand in the following order beginning with the lowest.

No.	No. of Tender.		Pin.	Riveted.
			\$	\$
1	23	Chas. Macdonald & Co., New York.....	276,672	
2	32	Blodgett & Curry, Boston.....	297,000	
3	B	Boxall and Burpee, St. John, New Brunswick		299,413
4	19	Clarke, Reeves & Co., Philadelphia.....	309,352	
5	20	A. Becker, Montreal	347,950	
6	28	E. R. Wiswell, New York	351,830	
7	31	Watson Manufacturing & Co., Patterson, New Jersey	363,900	
8	29	McNairy & Claflen, Cleveland	385,653	
9	A	R. Jas. Reekie, Montreal.....		385,925
10	18	Detroit Bridge & Iron Works, Detroit.....	387,495	
11	22	Fairbairn Engineering Co., Manchester		415,625
12	1	Campbell, Johnston & Co., London.....		423,315
13	30	American Bridge Co., Chicago	425,451	
14	27	C. Shaler Smith, Baltimore.....	432,910	
15	14	John Walker, London, Ontario.....		458,195
16	25	E. A. Jones, Londonderry, Nova Scotia.....		469,640
17	17	Thomas Evans, Belleville, Ontario.....		497,280

Taking the class of bridges given in the first column, designated the Pin Bridge, I have, after a careful investigation into the merits of the various plans which accompany the tenders, arrived at the conclusion that they stand in the following order, beginning with what may be considered the best.

Tender No. 27, C. Shaler Smith, Baltimore.

- " 31, Watson Manufacturing Company, Patterson, N. J.
- " 30, American Bridge Co., Chicago.
- " 18, Detroit Bridge and Iron Works, Detroit.
- " 19, Clarke, Reeves & Co., Philadelphia.
- " 29, McNairy & Claflen, Cleveland.
- " 26, Kellogg Bridge Co., Buffalo.
- " 32, Blodgett & Curry, Boston.
- " 3, Patent Shaft Co., Liverpool.
- " 6, Phoenix Engineering Works, Liverpool.
- " 23, Chas. Macdonald, New York.
- " 20, A. Becker, Montreal.

The five last would require alteration and additional material to fit them for use. The riveted bridges, in my opinion, stand in the following order of merit:—

Tender No. 22, Fairbairn Engineering Company, Manchester.

- " 1, Campbell, Johnston & Co., London.
- " 14, John Walker, London, Ont.
- " 25, E. A. Jones, Londonderry, N. S.
- " A, R. Jas Reekie, Montreal.
- " B, Boxall & Burpee, St. John, N. B.

I have no hesitation in saying that my opinion is very much in favor of the best of the riveted bridges as compared with the best of the pin bridges.

For the information of the Commissioners, I think it is proper that I should allude to the weights of iron intended to be placed in the bridges according to the several tenders, and the designs which accompany them, and in presenting this information I do not mean it to be understood that the strength and value of a bridge depends

in all cases mainly on the weight of material employed in its construction; on the contrary, of two bridges the heaviest may have its several members so unskillfully arranged and badly proportioned that the lightest may really be the strongest and most durable of the two; but when we take bridges of the same or very similar design, constructed of materials of equal quality, and assume that all the parts have been well proportioned in each case, the weights of span will give a tolerably correct idea of the relative strength and value of each.

The weights per span and the total weight of iron in the sixteen spans are presented in the following lists (as far as ascertained) and to enable the Commissioners still further to judge, the total amounts of the tender are divided by the total weights in each case, thus giving the price per ton.

TWO HUNDRED FEET SPANS, F. O. B.

TENDERS arranged according to Price per Ton.

No.	No. of Tender.	Name.	Weight in Tons.		Amount of Tender, F.O.B.	Price per ton, F. O. B.	
			Per Span.	16 Spans.		Pin.	Riveted.
1	5	Darlington Iron Co.....	161	2,576	144,024	.....	56 00
2	21	P. & W. McLellan..... {	255½	4,110	244,206	.....	59 00
3	C	Wm. Thompson & Co.....	260			.....
4	14	John Walker.....	183½	2,018	130,175	.....	64 50
5	10	Pease, Hutchinson & Co.....	243	3,888	276,720	.....	71 00
6	3	Patent Shaft Co.....	202	3,232	229,348	.....	71 00
7	22	Fairbairn Engineering Co.....	137	2,192	158,540	72 00	
8	12	Westwood, Baillie Co.....	244½	3,912	289,940	.....	74 00
9	33	John Cockerill.....	250	4,000	297,998	.....	74 50
10	A	R. Jas. Reekie..... {	206½	3,304	248,640	.....	75 00
11	4	Lewis & Stockwell..... {	140			.....
12	9	Hopkins, Gilkes & Co.....	143	3,044	236,955	.....	78 00
13	25	E. A. Jones.....	199			.....
14	B	Boxall & Burpee.....	186½	3,536	275,610	.....	78 00
15	20	A. Beaker.....	221			.....
16	32	Blodgett & Curry.....	140	2,240	223,328	.....	100 00
17	26	Kellogg Bridge Co.....	138	2,208	223,680	101 00	
18	18	Detroit Iron Works.....	126½	2,024	238,500	118 00	
19	19	Clarke, Reeves & Co.....	109½	1,748	213,248	122 00	
20	30	American Bridge Co.....	140	2,240	315,675	141 00	
21	29	McNairy & Claßen.....	101	1,616	243,852	151 00	
22	31	Watson Manufacturing Co.....	144½	2,312	387,160	167 00	
			128½	2,056	350,060	170 00	
			110½	1,772	333,100	188 00	

200 FEET SPANS, ERECTION INCLUDED.

TENDERS arranged according to Price per Ton.

No.	No. of Tons.	Name.	Weight in Tons.		Amount of Tender, erected.	Price per Ton, Erected.	
			Per Span.	16 Spans		Pin.	Riveted.
1	22	Fairbairn Engineering Co	244½	3,912	415,625	.....	106
2	14	John Walker	243	3,888	458,195	.....	118
3	1	Campbell, Johnston & Co	210	3,360	423,315	.....	126
4	25	E. A. Jones	221	3,536	469,640	.....	133
5	B	Boxall & Burpee	140	2,240	299,413	.....	133
6	33	Blodgett & Curry	126½	2,024	297,000	147 00	
7	20	A. Becker	138	2,208	347,950	157 50	
8	A	R. Jas. Reekie	{ 140 143 }	2,255	385,925	.....	171
9	18	Detroit Iron Works	140	2,240	387,495	173 00	
10	19	Clarke, Reeves & Co	101	1,616	309,352	191 00	
11	31	Watson Manufacturing Co	110½	1,772	363,900	205 00	

I trust the foregoing information will be sufficient to enable the Commissioners and the Government to make a selection from the Tenders submitted without difficulty.

I am, Sir,

Your obedient servant,

(Signed,)

SANDFORD FLEMING,
Chief Engineer.

No. 16.

INTERCOLONIAL RAILWAY,

OFFICE OF THE CHIEF ENGINEER,

OTTAWA, May 11th, 1871.

C. S. Ross, Esq., Secretary.

SIR,—In accordance with your verbal message sent over this morning, I submit the following respecting the Bridge Tenders:—

1st. A comparison of the Fairbairn prices with my own estimate for spans of 100 feet and 80 feet.

Fairbairn Engineering Co.'s Prices.			Chief Engineer's Estimate.		
Number and length of Spans.	Rate.	Amount.	Number and length of Spans.	Rate.	Amount.
	\$	\$		\$	\$
61 spans of 100 feet:—			61 spans of 100 feet.....	5,600	341,600
25 through bridges.....	5,941	148,525			
36 deck do	4,709	169,524			
10 spans of 80 feet:—			10 spans of 80 feet.....	3,750	37,500
8 through bridges.....	3,670	29,360			
2 deck do	2,834	5,668			
Total		\$353,077	Total		\$379,100

The Fairbairn prices appear to be \$26,023 lower than my own estimate for these spans.

2nd. The tenders for spans of 100 feet and 80 feet, *including erection*, are as follows :—

TENDER No. 1.—Campbell, Johnston & Co., London, England.

61 Spans of 100 feet, at \$6,287.....	\$383,507
10 Spans of 80 feet, at \$4,391.....	43,910

Total.....	\$427,417
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TENDER No. 14.—John Walker, London, Ont.

61 Spans of 100 feet, at \$6,387.....	\$389,607
10 Spans of 80 feet, at \$5,113.....	51,130

Total.....	\$440,737
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TENDER No. 19.—Clarke, Reeves & Co., Philadelphia.

61 Spans of 100 feet, at \$5,097.....	\$310,917
10 Spans of 80 feet, at \$4,088.....	40,880

Total.....	\$351,797
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TENDER No. 22.—Fairbairn Engineering Co., Manchester.

61 Spans of 100 feet, at \$4,709.....	\$287,249
10 Spans of 80 feet, at \$2,834.....	28,340

Total.....	\$315,589
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TENDER No. A.—R. Jas. Reekie, Montreal.

61 Spans of 100 feet, at \$7,425.....	\$452,925
10 Spans of 80 feet, at \$4,500.....	45,000

Total.....	\$497,925
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These tenders for the 100 feet and 80 feet spans *only*, stand in the following order with respect to price—*Erection included*:—

Tender No. 22.—Fairbairn Engineering Co.....	\$315,589
“ 19.—Clarke, Reeves & Co.....	351,797
“ 1.—Campbell, Johnston & Co.....	427,417
“ 14.—John Walker.....	440,737
“ A.—R. Jas. Reekie.....	497,925

3rd. Tenders embracing the 200 feet, the 100 feet, and the 80 feet spans stand in the following order with respect to price—*Erection included*:—

Tender No. 19.—Clarke, Reeves & Co.....	\$661,149
“ 22.—Fairbairn Engineering Co.....	731,214
“ 1.—Campbell, Johnston & Co.....	850,732
“ A.—R. Jas. Reekie.....	883,950
“ 14.—John Walker.....	898,950

With respect to merit I am decidedly of opinion that Tender No. 22 stands in the first position.

I am, Sir,

Your obedient servant,

(Signed,) SANDFORD FLEMING.

Chief Engineer.

No. 17.

Report of the Commissioners to the Honorable the Privy Council.

OTTAWA, 11th May, 1871.

The Commissioners for the construction of the Intercolonial Railway, have to report to the Governor in Council upon tenders for iron bridges, which were duly advertised.

Thirty-six tenders were received as per list appended hereto.

Two reports from the Chief Engineer of date 5th and 11th instant, were also received, of which copies are also appended.

In accordance with the Order in Council of date 19th January, 1871, tenders were asked for all bridges of upwards of 60 feet span. These include:—

16 spans of 200 feet.
61 “ of 100 “
10 “ of 80 “

Tenders were invited for either free on board, or erected in place.

Two tenders were received for all the bridges erected in place, and the Commissioners are of opinion that it would not be desirable to accept tenders free on board, and have to encounter the cost and risk and delay of bringing the parts to the different points of erection and constructing them at the risk of the Government.

In other respects the most satisfactory tenders are those for the bridges erected in place.

Dealing with tenders “in place,” the following is the result, viz:—

	200 ft. span.	100, & 80 ft. span.	Total.
Campbell, Johnston, & Co.,.....	\$423,316	\$427,417	\$850,733
John Walker.....	416,688	440,737	857,425
Clarke, Reeves & Co.,.....	309,352	351,797	661,149
Fairbairn Engineering Co.,.....	415,625	315,589	731,214
R. J. Reekie.....	385,925	497,925	983,850

The Commissioners are of opinion that it will be most economical to divide the contract, giving 200 feet span bridges to one firm, and the 100, and 80 feet span bridges to another firm.

They therefore recommend that the tender of Messrs Clarke, Reeves & Co., be accepted for 16 spans of 200 feet, at the price of \$309,352, erected in place, and that the tender of the Fairbairn Engineering Co. be accepted for the 61 spans of 100 feet, and for the ten 80 feet spans at the price of \$315,589 for the whole erected in place.

This will make the total cost of the 87 spans, ordered by Council, to be tendered for, \$624,941.

The bridges to be made and erected by the Fairbairn Engineering Company, will be of the English Lattice Truss, and those to be erected by Messrs. Clarke, Reeves & Co., are known as the American Pratt Truss, which has been in successful use for many years in the United States, and is now being very extensively erected there.

The Commissioners have also been requested to report upon a letter from the Chief Engineer of date 6th May, on the subject of the bridges of sixty feet span and under.

It appears that he asked for tenders for these smaller bridges, and nearly all the parties who tendered for the other bridges have sent tenders for these also.

They consist of 19 spans of 60 feet.

22 “ 50 “
21 “ 40 “
5 “ 30 “
2 “ 24 “

The tenders for the above sixty-nine spans, erected in place, are as follows:—

Campbell, Johnston & Co.....	\$103,038
John Walker.....	92,520
Clarke, Reeves & Co.....	155,868
Fairbairn Engineering Co.....	91,425
R. J. Reekie.....	144,140

The Commissioners looking at the small amount involved in these bridges, and to the fact that a considerable quantity of masonry will be saved by their adoption, recommend that the tender of the Fairbairn Engineering Company, for the sum of \$91,425, be accepted.

The total cost of all the bridges erected in place will be \$716,366.

The tenders of the Fairbairn Engineering Company, and of Messrs. Clarke, Reeves & Co., are the lowest in each case, and the well known reputation of these firms, and the large quantity of bridge work which they erected and are now engaged in erecting, enables the Commissioners to report with entire confidence as to their skill, experience and resources for the execution of the work.

(Signed,)

A. WALSH,

C. J. BRIDGES,

Commissioners.

No. 18.

COPY of a Report of a Committee of the Honorable the Privy Council, approved by His Excellency the Governor General in Council on the 12th May, 1871.

The Committee of Council have had under consideration the annexed report from the Commissioners for the construction of the Intercolonial Railway, under date of 11th May, 1871, submitting a list of tenders received for the construction of iron bridges on that line, and on the recommendation of the Honorable the Minister of Public Works, they respectfully advise that the tenders of Messrs. Clarke, Reeves & Co., for sixteen spans of 200 feet, erected in place, for the sum of \$309,352; and that of the Fairbairn Engineering Company for the bridges of sixty-one spans of 100 feet, and the ten bridges of eighty feet span, for \$315,589, the whole erected in place, be accepted. Also, that the tender of the above-mentioned Fairbairn Engineering Company, for the bridges of sixty feet span and under, for the sum of \$91,425, be also accepted, as suggested in the said annexed report.

Certified.

W. A. HILMSWORTH,
Clerk, Privy Council.

2nd Session, 3rd Parliament, 33 Victoria, 1875.

RETURN

TO ADDRESS of the House of Commons,
dated 18th May, 1874: For a State-
ment of the cost of the Bridges on the
Intercolonial Railway, showing the
comparative costs of Spans of Wood
and Iron, with all Correspondence and
Reports of the Commissioners, En-
gineers and others, submitted to the
Government, and all Orders in Council
on the Subject.

Printed by Order of Parliament.

(TT. WA :

Printed by Macleay, Roger & Co., Wellington Street,
1875.



